AMASS DATA TECHNOLOGIES INC.

Operational and Maintenance Manual

for

Pliant Data Logger Product Line

PDAS-IIII

& Options: HDR, MDM, PSE, PSE/D

Hardware Revision H

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Updated: August 11th, 2008

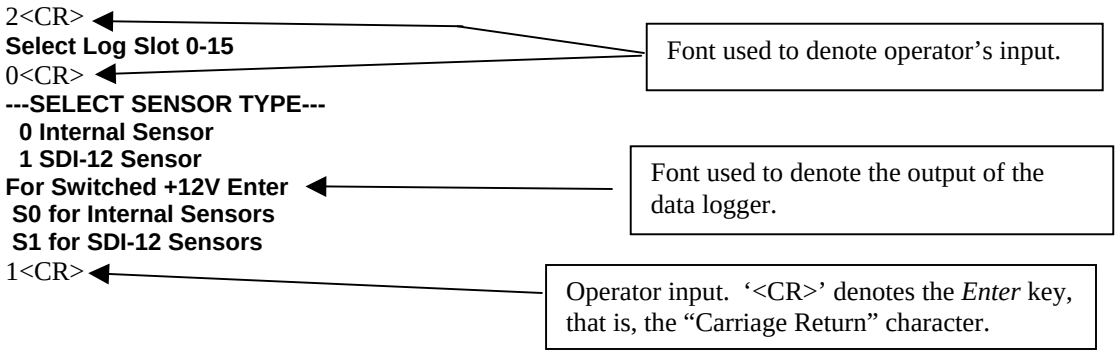
Web page at http://www.amassdata.com

List of Amendments

Amendment #	Reason or comments	Date	Affected pages
Original release	Firmware 3.0 for PDAS-III rev H	Dec. 13th, 2006	
#1	Clarify difference between Event Counter#1 and #2 (i.e. switch closure vs pulse counting).	August 11th, 2008	1-2, 4-8, 10-1

Conventions used in this manual

Given that the PDAS data logger features a built-in menu system, this manual provides many examples of exchanges between the user and the logger. In order to easily distinguish between characters that are displayed by the logger and those that are entered by the user, the following convention has been adopted:

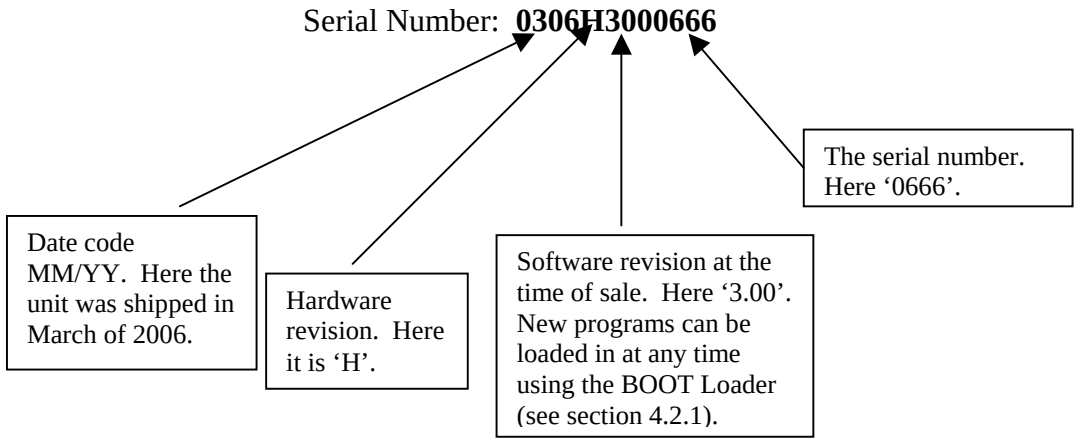

2<CR>
Select Log Slot 0-15
0<CR>
---SELECT SENSOR TYPE---
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
1<CR>
Font used to denote operator's input.
Font used to denote the output of the data logger.
Operator input. '<CR>' denotes the *Enter* key, that is, the "Carriage Return" character.

Chapter 5 contains detailed descriptions of the menu system hierarchy. Sub-sections within this chapter correspond to the *Main Menu* selection. Therefore, section 5.2 corresponds to selection **2 View Data.** The options within these submenus are described at the arrow symbol as follows:

⇒ Selection '1' allows the user to view real-time data from the sensor set-up in the *Sensor Log Table* . . .

SCOPE OF THIS MANUAL: This manual describes the PDAS-III data loggers with hardware revision H. The hardware revision of the unit is embedded in its serial number as follows:

EXAMPLE: A serial number of 0306H3000666 denotes a hardware rev of "G". The only letter in the serial number is the hardware revision. The meaning of the other numbers is as follows:


Serial Number: 0306H3000666
Date code MM/YY. Here the unit was shipped in March of 2006.
Hardware revision. Here it is 'H'.
Software revision at the time of sale. Here '3.00'. New programs can be loaded in at any time using the BOOT Loader (see section 4.2.1).
The serial number. Here '0666'.

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PDAS-IIII

AMASSER Pliant Data Acquisition System

Pliant Technology Specialists

Pliant: readily yielding to influence

1. AMASSER PDAS-III Loggers

The PDAS product line features intelligent data collection platforms with built-in menu facility that guides the operator through log set-up procedures and data retrieval procedures directly from a laptop, or via a modem, or even via GOES telecommunications. These procedures are accomplished with any standard ASCII communications package such as PROCOMM or simply a dumb terminal emulator and are thus not dependent on the Operating System of the host. This is a great advantage over many of today's products that are configured specifically to operate with a given system and where compatibility is always an issue.

The on-site capability of the AMASSER PDAS-III data acquisition system to acquire, process, store and, as required, transmit data via available communication systems will increase the user's flexibility in the operation of the various data acquisition programs under their control. Probably of even greater importance is that the timeliness and cost effectiveness with which this data can be delivered to the user community will provide the incentive for a reevaluation of our ability to manage our ever-changing natural resources.

The AMASSER PDAS-III Data Acquisition System is provided with a real time multi-tasking operating system kernel capable of providing both a time and event driven environment in which data is collected, processed, logged and distributed across multiple mediums reliably. This firmware also uses the power saving support of both the idle and power down modes available on the processor to allow savings in both the size and the price of the power source equipment needed to run your requirements. This environment supports multiple tasks executing on a single processor and prevents problems such as loss of data or loss of communications when two or more events occur in the same time frame.

This manual covers the operation of the PDAS-III loggers. The standard features of the PDAS are described in section 1.1 Standard Features whereas its options are listed in section 1.2 Hardware Options. The standard PDAS comes with firmware providing modem support, however, it is also available with the firmware options listed in section 1.2 Hardware Options. The user simply uploads the desired firmware or selects the previously loaded firmware as described in section 4.2 SOFTWARE UPGRADES.

New-users of this data logger may refer to section 4 OPERATION and 4.3 HOW TO …. Otherwise, a detailed description of the complete menu hierarchy is found in section 5 MENU TREE REFERENCE as follows:

Section 5.1 corresponds to selection '1' of the main menu. It is where the GOES transmitter is configured for models with GOES support (PDAS-III/HDR). For models with a built-in modem (PDAS-III/MDM or PDAS-III/MDM/V) this selection is simply where the date and time are set.

Section 5.2 corresponds to selection '2' of the main menu. This is where the user can view real-time data from sensors configured for logging as well as captured blocks of data.

Section 5.3 corresponds to selection '3' of the main menu. This all-important section is where the user configures the logging schedule of all sensors, including any user-defined conversion equations.

Section 5.4 corresponds to selection '4' of the main menu. This section is where the user downloads the logged data.

Section 5.5 corresponds to selection '5' of the main menu. This is where the user configures alarm functions. The programmable alarms have the ability of triggering another function when user-defined conditions are met.

Section 5.6 corresponds to selection '6' of the main menu. This section provides miscellaneous functions with respect to setting the logger ports, SDI-12 transparent mode, …

1.1. Standard Features

The following summarizes the standard features of the PDAS-III product line:

Hardware Features:

Name	Description
AIS	On-board Analog Input System for monitoring the following maintenance parameters: Primary source voltage, Lithium battery voltage and Internal temperature. Also pre-configured with four external 0-5V inputs . These may also be configured to 0-2.5V, 0-1V or +/-100mV. The A/D provides these inputs with 16 bit resolution. Outputs of 2.5 & 5V reference are provided. Includes 2 event counters (port 1 for switch closure, port 2 for pulses).

Plus the following:

- One SDI-12 Serial Digital Interface (10 sensor support) port labeled Channel A plus a pseudo SDI-12 port B for connection of the AMASS Data PRF Radio Modem. The hardware interface of both channels is configurable (jumpers) to either standard SDI-12 (HCMOS) or RS485.
- One switched +12VDC power port for sensor activation with user-definable time-delay prior to sampling
- RS-232 Programming Port programmable from 300 to 19200 baud
- Separate connectors are provided to support an internal modem and a GOES transmitter. Both of these telemetry options may be installed on the logger.
- 1 Mbyte Non-Volatile Flash memory Log File providing 32,768 records (32-bytes each)
- Average and Min/Max values determined from a user-definable block of data (number of samples and sampling rate)
- Battery-backed memory. Two code spaces selectable from the BOOT LOADER (see 4.2)
- Lithium battery back-up for 32 kbyte RAM
- Real Time Clock for date/time stamping of data
- NEMA 4, 12 steel environmental casing. Complete EMI/RMI shielding. All user connections are made externally to the casing.

Firmware Support Providing:

- Support for Modem communications
- Sensor Log Table with 16 sensor slots for the attached SDI-12 sensors and individual setup for:
  - ⇒ User defined sensor Label
  - ⇒ Sample period setting (minutes : seconds)
  - ⇒ Command string for measurement initialization of SDI-12 sensors
  - ⇒ Conversion equations with Offset and Scale
  - ⇒ Instantaneous or Average log value (record period in hour : minutes)
  - ⇒ Minimum, Maximum log record period (hour : minutes)
  - ⇒ Sensor sample Start Time (hour : minutes)
- 32,768 log records, each 32 bytes in length containing Date & Time, User-defined Label and Data
- Data-conversion capability including polynomials
- Data block log capability with user-definable number of samples and sampling period
- View Data Facility (selected sensor data written to Host Terminal at a user-defined rate, real-time)
- SDI-12 Transparent Mode (Manual SDI-12 Communications)
- User-selectable data formats for log retrieval: Excel/Lotus Format, Environment Canada "Sequential" Format or Environment Canada "Tabular" Format.
- **ALARM** functions that have the ability of triggering a new logging rate or reading another sensor.

1.2. Hardware Options

Name	Description
/HDR	Seimac SAT HDR GOES transmitter with PDAS-III menus providing comprehensive initialisation and diagnostics routines. See section 5.1.1.
/PSE	Built-in shaft encoder water level sensor for the PDAS-III. Note that this is in fact the AMASS Data PSE-SDI incorporated into the same casing. It features a resolution of 1/400th of a revolution.
/PSE/D	Same as the **/PSE** option except that it also features an 8-digit display and two operator interface switches. Refer to section 2.2 PSE/D Display Operation.
/MDM	Built-in AMASS Data **PMDM** Environmental Modem. Very-low power mode, powered by 12VDC, operating temperature of –40 to +85C, 9600 baud or 14.4 kbaud. Refer to documentation for **PMDM.**
/MDM/V	Built-in **PMDM/V** Environmental Voice Modem. The **PMDM** described above with voice interface for telephone call-ins. Refer to documentation for **PMDM/V.**

2. BUILT-IN SHAFT ENCODER: OPTION "/PSE"

The built-in shaft encoder, i.e. option "/PSE", is in fact the AMASS PSE-SDI incorporated into the same casing. For complete details of this sensor please refer to the datasheet for the PSE-SDI.

The resolution of the encoder is 1/400th of a revolution (minimum); when used as a stream stage indicator with a 375 mm circumference pulley, the resolution of the system is 0.94 mm. It is a two channel optical incremental encoder that contains a lensed LED source, integrated detectors, and a codewheel which rotates between the emitter and the detector. The PSE-SDI firmware provides pulsed LED driver and an adaptive signal transition detector to provide the 4x quadrature decoder function. This technique, in conjunction with idle power-down mode of the processor, drops the encoder's current consumption from 45 milliamps to 2.3 milliamps. A HUGE power savings.

There are no mechanical contacts involved in the measurement process; the only contacting moving parts are the precision shaft bearings. The starting torque is low -- 0.65 inch-oz (47 cm-g) or less -- and the system is not sensitive to vibration. It is tested to operate from -40C to +55C, and up to 100% relative humidity.

2.1. Quadrature Encoder -Principle of Operation

The on-board microcontroller and firmware follows the shaft rotation; each transition of either of the quadrature inputs adds or subtracts a count to a 16 bit stored value representing the position of the shaft and therefore the fluid level. A set-up parameter called *scale* is provided to allow the application of a standard-circumference pulley and tape so that the accumulated count represents an accurate fluid level. If using a 375mm-circumference pulley for instance, the accumulated count would directly indicate a fluid level in metres by setting the scale = 0.375. The output from the microprocessor is the ASCII code representation calculated to three decimal places and is equal to the position value stored in the internal register divided by 384 (Model K encoder). The output will be a decimal value in the range +/-999.999 units. The encoder's scale and offset are set using the menu system as described in Main Menu: SYSTEM SETUP or using the 8-digit display for "\PSE\D" models (see section 2.2).

For example, if you are using a 375mm-circumference pulley and you wish to measure the stage in metres above sea level you would enter a "scale" of 0.375 and an "offset" equal to the stage level above sea level at setup time. If the measured stage is 101.225 metres above sea level at setup time, you would enter an "offset" of 101.225 and the unit will now track your stage in meters above sea level.

2.2. PSE/D Display Operation

The "/PSE/D" option comprises an 8-digit display and two double-position switches that control the display and setup of parameters. The setup parameters are only accessible however, once the correct password has been entered. The front of the unit appears as in Fig.1.

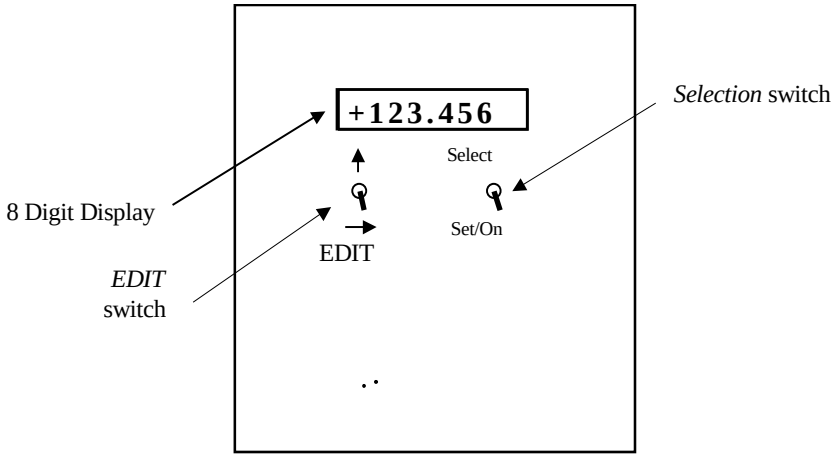


Figure 1. Front panel of /PSE/D models.

The four switch positions allow the user to display the current fluid level as well as setup the following parameters: the encoder offset and scale, the node address for SDI-12 communications and the averaging parameters as per section *Set Averaging Parameters* in the PSE-SDI user manual.

The right switch is used to *select* the parameter to be displayed and/or altered. It is also used as an enter key to *set* the new values of setup parameters, and as an *on* switch for the display. The left switch allows the user to *EDIT* the value displayed at the screen. The lower position of this switch is labeled with a right-arrow and is used to select the digit that is to be edited; the "active" digit is the one flashing on the screen. The upper position, which is labelled with an up-arrow, edits the active digit by scrolling through the available options: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ., +, -.

Note that when entering values for the offset and scale the decimal point must be entered as these parameters are floating point variables. The "+" or "-" sign must also be entered for these parameters. For instance, a scale of +1.000 may be entered as "+1." but not as "+1", "1." or "1". It is a good practice to review any changes by scrolling down the display using the *set/on* switch and making further alterations is necessary.

The display comprises an auto power-off feature. It switches the display off following an inactive period of approximately 5 minutes in order to save energy. Note that although the PSE-SDI\D consumes as little as 5 mA when the display is off the current consumption is about 90 mA when it is on.

2.3. View the Current Level

To use the display to view the current fluid-level turn it on with *set/On*. The current fluid level appears.

2.4. Accepting/Changing the Password

Set-up the PSE\D using the display (set-up may also be accomplished via the menu system as per section 5.6) as follows:

- Switch it on with *Set/On*. The current encoder position, i.e. water level, is displayed.
- Now use *select* until "PASSWORD" appears then use *set/On* ("+000" appears).
- The default password of "+000" is displayed.
- Use *Set/on* to accept the current display as the password (or use the *EDIT* switch to change the display to the correct password if it has been changed). Note that the correct password must be entered to gain access to the setup parameters.
- You have the option of defining a personal password using the *EDIT* switch. When entering the four-character password the following characters are valid: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ., +, -, <space>. The password can only be viewed or altered from the display and must be entered correctly to view the remaining setup parameters. **To set the password equal to the characters displayed on the screen press the *Set/On* switch.**

Note that the correct password that was entered to gain entry to the setup parameters can be viewed as long as the display has not switched off with the auto power-off feature. Note that if the display does shut off and is turned back on, "PASSWORD" will display the default value, namely "+000", which must be edited once again to obtain access. Never forget your password otherwise you will not be able to change the setup parameters from the display at a later date. In the event that it is forgotten contact AMASS Data Technologies Inc.

2.5. Set the "Scale" and "Offset"

- Turn on the display with *Set/On*.
- Push switch to *Select* until the word 'PASSWORD' appears.
- Push switch to *Set/On*. The default password appears: '+000'.
- Enter the correct password then press *Set/On*. .
- Push *Select* until the word "SCALE" or "OFFSET" appears.
- Push *Set/On*. The current value of the parameter appears.
- Make changes with the *EDIT* switch and accept the new value with *Set/on*, OR cancel your changes by pushing *Select*.

2.6. Set the Node Address

- Turn on the display with *Set/On*.
- Push switch to *Select* until the word 'PASSWORD' appears.
- Push switch to *Set/On*. The default password appears: '+000'.
- Enter the correct password then press *Set/On*.
- Push *Select* until "NODE ADR" appears.
- Push *Set/On*. The current node address appears.
- Make changes with the *EDIT* switch and accept the new value with *Set/on*, OR cancel your changes by pushing *Select*.

3. BUS PROTOCOLS

3.1. DAS Communications Protocol

All information that is relayed between the host (PC, automatic data collection system, etc…) and PDAS loggers is accomplished by means of the DAS communications protocol. This protocol results in messages being transferred in a RS232 data stream and uses relaxed timing and no break handling. Each command or response is simply terminated with the *carriage return* character. When operating the PDAS, however, the details of the protocol are far removed from the user as this product is menu-driven which allows one to interact in a user-friendly manner without having to be concerned with details such as command syntax.

In order to communicate directly with SDI-12 sensors from the host, i.e. the SDI-12 transparent mode, the SDI-12 commands are basically encapsulated into the DAS protocol.

3.2. SDI-12 Protocol

The PDAS-III, in most versions, supports one standard SDI-12 port (port A) and a pseudo SDI-12 port for supporting the AMASS DATA PRF Radio modem. Contact AMASS DATA with the software version number of your unit to confirm how many standard SDI-12 ports are available to you. This section briefly describes the standard SDI-12 protocol.

One SDI-12 port will support 10 SDI-12 sensors. Any communication between the PDAS-II and the SDI-12 sensor must employ the SDI-12 protocol. Any communication between the host PC and the SDI-12 sensors must employ, in “transparent mode”, the SDI-12 protocol. The “transparent mode” allows the user to send and receive SDI-12 messages via the DAS protocol by encapsulating the SDI-12 string into the RS-232 data stream.

SDI-12 sensors may be monitored and logged as well as accessed for immediate and real-time data. If the user wishes to type manual SDI-12 commands he/she must use the “transparent mode” as explained in 5.6 Main Menu: SYSTEM SETUP. In order to monitor and log data from sensors the user must assign them to “slots” in the “Sensor Log Table” as explained in 5.3 Main Menu: SENSOR LOG TABLE. In the case of SDI-12 sensors, the logger sends the appropriate SDI-12 command to initiate a measurement and automatically performs any breaks, D commands, retries, etc… as required by the SDI-12 protocol. It then logs the value that it retrieved into the log file. What follows is an overview of the SDI-12 protocol. **For detailed information on SDI-12 protocol visit the SDI-12 Support Group’s web-site via our home page at http://www.amassdata.com.**

In order to initiate communication with an SDI-12 sensor, the controller sends a "break" signal, which consists of sending a spacing signal (5 V) for more than 12 millisec. This will wake all sensors connected to the line. The controller then sends an SDI-12 command. The format of each byte of data is 1 start bit, 7 data bits with the least significant bit first, 1 parity bit with even parity, and 1 stop bit. The first significant byte of any message is the address of the sensor; all sensors with different addresses return to the "sleep" state and ignore the rest of the command. The last character of a command is always "!", and the controller turns off its transmitter within 7.5 millisec after sending the "!". The sensor responds by setting the data line to marking (0 V) for 8.33 millisec, and then begins its response. The first bit of the response must be sent within 15 millisec of receiving the last byte of the command.

Any SDI-12 device may be connected to the SDI-12 ports. For example, with the AMASSER PSE-SDI Shaft Encoder the current value of the water level, stream stage, or other quantity being measured may be retrieved by sending a start measurement command, that is, “aM0!”. The PSE-SDI maintains in its memory a number which represents the current water level so that upon receiving the "Measure" (aM0!) command from the PDAS-SDI, it transfers this value to the output buffer in the required ASCII format based on the offset and scale parameters; and upon receiving the "Send Data" (aD0!) command, the value from the output buffer is returned to the controller.

NOTE: SDI-12 sensors may return up to 9 data values according to its Specification.

4. OPERATION

4.1. Getting Started

Begin by installing the PDAS-III logger as per section 8. For a quick test, put the PDAS-III on the bench and power it up using a 12V source via the supplied cable. The power connections must be as shown in Figure 7 on page 8-11. The PDAS-III can now be configured for logging using a direct connection to the *Programming Port* (see Figure 7) using the supplied *Programming cable,* or via modem for loggers so equipped ("/MDM" or "/MDM/V" in the product name).

As mentioned in the introduction to this manual, the PDAS-III does not have host OS requirements. All that is required for communications to the PDAS-III logger is a dumb terminal emulator with "capture" capability. What follows is the procedure for initiating a dumb terminal emulator with Windows XP as this is the most commonly used OS on the market at this time. A similar procedure can be accomplished on any other OS that allows the user to run a dumb terminal emulator.

- Click on *Start* then go to *Programs* → *Accessories* → *Communications* then click on *HyperTerminal*
- Click on the *Hypertrm* icon
- Type the name "amasser" in the window and select an icon. Click *OK*

The steps that follow differ slightly whether the user is connecting via modem or without modem. Follow these steps WITHOUT MODEM:

- In the window labeled "Connect using" select "Direct to com #", where # is your com port connection. Click *OK*
- Select a baud rate of 38400 (by default but it could also be 9600, 2400, 1200 or 300 baud), 8 data bits, no parity bits, 1 stop bit and HARDWARE flow control then click *OK*
- Set the font by clicking on *View* on the menu bar, then on *Font…*Select the font, "Courrier", the font style, "Regular", and the size, "8" (suggested font only). Click *OK.*
- Using the *Programming Cable* supplied with the logger (do not use a standard RS232 cable), connect the PDAS-III to the serial port of the computer. Proceed to ***.

OR WITH MODEM (connect telephone line to RJ11, see 8.3):

- In the window labeled "Connect using" select the modem of your choice, such as "Standard Modem" or "Modem at Com#2" for example.
- Enter the phone number and area code to be dialed to access the logger then click *OK.*
- Click on *Modify*. Click on *Configure*. In the section labeled *Maximum Speed,* **select the baud rate to be 9600.**
- Click on the tab labeled *Connection*. Select 8 data bits, no parity bits and 1 stop bit.
- Click *OK.* Click *OK* again, then finally click on *Dial.*
- Once connected the user may which to change the font. Click on *View* on the menu bar, then on *Font…* Select the font, "Courrier", the font style, "Regular", and the size, "8" (suggested font only). Click *OK.* Proceed to ***.

*** The terminal window should now appear. To have a record of the session, or if the user is prompted to "capture" a file, proceed as follows:

- Click on *Transfer* on the menu bar, then on *Capture text…*
- Type a path and file name for the new session then click on *Start*

The ensuing transaction between computer and PDAS-III will now be recorded in the captured file. This captured file can either be viewed in a text editor or loaded into another logger in the case of a *Configuration File* (see 4.2).

When the session has terminated simply click on the "Disconnect" button on the toolbar, close the emulator window and open the capture file which now contains the entire hosting session. Note that upon closing the

emulator window a message such as “Do you want to save session AMASSER?” will appear. Click *Yes*. An icon with the label “amasser” should then appear. This icon may be dragged onto the desktop if so desired. To initiate any future sessions the user need only click on the icon.

Note that although the baud rate of the programming port defaults to 38400, it is in fact programmable from 300 to 38400 baud and is accomplished from the *System Setup* submenu (see below).

Now that the emulator window is on the screen and that the “Capture text” has been initiated the user can begin using the menu system as described in the following section.

4.2. SOFTWARE UPGRADES

The software that is resident in the PDAS-III is upgradeable from your PC without changing any hardware in the logger. This is accomplished via the *Programming Port* using the **BOOT LOADER** as described below. Other functions that may be accomplished from the BOOT LOADER are to load or retrieve the configuration of the logger (i.e. logging schedule, log file header, etc…), perform a first-time-initialize (required following some upgrades) or to select which memory space you wish to update/run: 'A' or 'B'.

NOTE: Enable the Local Echo feature of your terminal when communicating with the PDAS-III logger. This is particularly useful when loading in new programs into the logger.

4.2.1. BOOT LOADER

Access the BOOT LOADER menu as follows:

1. Connect the *Programming cable* to your computer and to the *Programming port* of the logger.
2. Apply the power source to the logger.
3. The following prompt should be displayed on the screen:

Press Enter for Boot Loader >

4. IF you wish to enter the BOOT Loader, press the "ENTER" key within 5 seconds of the appearance of the prompt and the following menu appears:

<CR>
---BOOT LOADER MENU---
0 SELECT PROGRAM - A
1 LOAD PROGRAM FILE
2 LOAD CONFIGURATION FILE
3 FIRST TIME INITIALIZE
4 START LOGGER
5 RETRIEVE CONFIGURATION

Note that the BOOT LOADER menu is also accessible from the Main Menu as follows: **Main Menu → System Setup → Logger Setup → Bootstrap Loader.**

4.2.2. Loading New Software

The PDAS-III loggers are equipped with two code memory-spaces: labeled 'A' and 'B'. Therefore, two programs may be stored in these loggers at any given time. You may, for example, have been running program 'A' at the time the new software is to be loaded into the logger. You may then opt to load the new software into 'B' so that if a problem occurs you may revert to program 'A'. Memory space selection is accomplished from the BOOT LOADER menu.

1. **Begin by selecting the memory space that you want to load into. Do this by pressing '0' for '**0 SELECT PROGRAM**' from the BOOT LOADER menu. The active program (or memory space) is displayed and toggles between 'A' and 'B'.**
2. **When the desired program is displayed ('A' and 'B'), select '**1 LOAD PROGRAM FILE**'.**
3. You are then prompted to erase the software in the current memory space before proceeding. Type 'Y' for 'Yes' (case sensitive).
4. You are prompted to press '*Enter*' to proceed.
5. You are then prompted: **Upload program now!**. At this point the PDAS-III is in receive mode. DO NOT TYPE ANY CHARACTERS OR PRESS '*Enter*'. If using Hyperterminal, click on "**Transfer**" at the top of the window, then click on "**Send Text File…"**. In the box labeled "Files of Type" select "all files".

Browse for the new software to be loaded into the logger. These files always have the extension '.HEX'. Select the file, then click on the "**OPEN**" button. The file is now being transferred to the logger. If your terminal has local echo enabled you will see characters scrolling by on the screen.

NOTE: Do not load a program that is stored on your floppy. This will prolong the procedure.

6. Wait until the logger displays a message to indicate that the upload is complete. DO NOT TYPE ANY CHARACTERS OR PRESS "*ENTER*" WHILE WAITING. This message is either "**Upload successful**" or something like "**Failure error #1'.** The time taken for loading in new software varies and depends on your computer, but is about one minute on average.

4.2.3. Load/Retrieve Configuration

The BOOT LOADER allows the user to load or retrieve configuration files. The configuration file contains the logger set-up including the logging schedule, log file header, etc… This feature allows for quick set-up of multiple loggers with the same configuration. The factory can also e-mail a configuration file if the customer requires assistance in the set-up of a logger.

⇒ Selection '**2 LOAD CONFIGURATION FILE'** allows the user to upload a *Configuration file.* Successful completion of the upload is accomplished when the screen displays "UPLOAD SUCCESSFUL!". Ensure that your communications terminal is set to "Local Echo On". *Configuration files* are generated by selection of '5 RETRIEVE CONFIGURATION'.

⇒ Selection '**5 RETRIEVE CONFIGURATION'** is used to generate a Intel Hex file which is the image of the Ram memory. This file, the *Configuration file,* can then be uploaded to other PDAS-III loggers (rev E) using selection '2 LOAD CONFIGURATION FILE' in order to greatly facilitate setting-up multiple units. The retrieval of the file is accomplished with the "Capture" utility of your communications program as prompted by the PDAS-III.

LOADING A CONFIGURATION:

1. Select '**2 LOAD CONFIGURATION FILE**'.
2. You are prompted as follows: '**Upload configuration now!**'.
3. At this point the PDAS-III is in receive mode. DO NOT TYPE ANY CHARACTERS OR PRESS '*Enter'*. If using Hyperterminal, click on "**Transfer**" at the top of the window, then click on "**Send Text File…"**. In the box labeled "Files of Type" select "all files". Browse for the new configuration file to be loaded into the logger. *Configuration files* are generated by selection of '5 RETRIEVE CONFIGURATION' explained below. Select the file, then click on the "**OPEN**" button. The file is now being transferred to the logger! If your terminal has local echo enabled you will see characters scrolling by on the screen.

NOTE: Do not load a configuration file that is stored on your floppy. This will prolong the procedure.

4. Wait until the logger displays a message to indicate that the upload is complete. DO NOT TYPE ANY CHARACTERS OR PRESS "*ENTER*" WHILE WAITING. This message is either "**Upload successful**" or something like "**Failure error #1'.** The time taken for loading in a new configuration file varies and depends on your computer, but is about 30 seconds on average.

RETRIEVING A CONFIGURATION:

1. Select '**5 RETRIEVE CONFIGURATION**'.
2. The following prompt appears:

Set Capture File ON! Then
Press Enter to continue!

If using Hyperterminal, click on "**Transfer**", then on "**Capture Text…**". In the box labeled "File", type a path and filename. Click on the "**Start**" button. Press "*Enter*".

3. The PDAS-III is now transmitting data to your computer. This data is being "captured", or logged to the specified filename.
4. Wait until the following message appears:

Stop Capture File NOW! Then
Remove this message and the initial <Enter>
From captured file before using.
Press Enter to continue.

In Hyperterminal, click on "**Transfer**", then on "**Capture Text**", then on "**Stop**". Press *Enter* to return to the BOOT LOADER menu.

5. Launch the application "NOTEPAD", or some other text editor. Open the captured file.
6. You must modify the file as follows: remove the first character in the file (a <CR> character) as well as the message shown in item 4 above. The latter is at the end of the file. Save the file.
7. This configuration file is now ready to be loaded into other PDAS-III loggers using the procedure described above.

4.2.4. Other BOOT LOADER Features

⇒ Selection '**3 FIRST TIME INITIALIZE**' allows the user to perform a first-time initialize of the PDAS-III, that is, a software reset. This clears the data space of the RAM. ONLY DO THIS AFTER LOADING NEW FIRMWARE, or as instructed by AMASS Data when firmware upgrades are delivered.

NOTE: Selecting '3 FIRST TIME INITIALIZE' will erase the entire configuration of the logger (eg. logging rates, sensor set-up, …). Logged data is unaffected.

⇒ Selection '**4 START LOGGER**' is used to resume normal operation of the logger. Selecting '' launches the current program that is displayed in the BOOT LOADER menu, that is, either 'A' or 'B'.

The BOOT LOADER MENU is also accessible from the *SYSTEM SETUP* menu (see sect 5.6).

4.3. HOW TO …

4.3.1. SETUP AN SDI-12 SENSOR

The PDAS-III provides SDI-12 communications capability for connection to standard SDI-12 sensors. SDI-12 sensors have three wires to be connected to the logger: +12V, ground and SDI-12 data. The connections are made to the detachable terminal strip as shown in section 8.3.

Once connected, the user can verify that communications between the sensor and logger are sound. Simply enter the correct password (AMASSER) to the menu (see section 5 on page5-2) and select **6 System Setup → 3 Transparent SDI-12 mode**. The user must refer to the command set that is listed for that sensor in its user reference manual. Then type a command such as:

Enter SDI Command String: A(a(Command+parameters))!
A?I!<CR>

Assuming the sensor is connected to channel A, the SDI-12 command must be preceded with an 'A'.

013AMASS Data PSE/D100

Response from sensor at address '0'.

…another example,

B?I!<CR>

Assuming connection to channel B.

013AMASS Data PAIM/C100

These, or similar responses, confirm that communication has been established with the sensor. Error messages indicate improper connections (see 8.3) of the sensor, improper addressing in the command or even a defective sensor. Note that the '?' character in the command line above is a wildcard for the address and that this technique should only be employed when there is a single sensor connected to any given SDI-12 channel, otherwise the proper address must be used (eg. 0, 1, 2, 3, 4, 5, 6, 7, 8 or 9).

Now configure the SDI-12 sensor (*scale, offset, address,* etc…) using the appropriate SDI-12 commands as per the command set listed in the manual of the sensor.

Now the logger can be configured to sample and log data from the sensor. This is done from **3 Sensor Log Table.** Select **0 Display Log Table.** This table contains the logging schedules of all parameters at a glance. Now select **2 Add/Edit Sensor** to insert the SDI-12 sensor into one of the 16 slots for logging. The menu system guides the user through the process. When doing so the user will be prompted for a *value position, sampling time, logging time* (instantaneous or averaged data?), *conversion equation*, *min/max logging time*, s*ampling start time, min/max start time.* A definition for each of these settings is found in section 5.3. A simple configuration would be as follows:

value position: 1. This indicates which of the returned data values is to be logged. Must be between 1 and 9.
sampling time: 15 minutes. Enter "00:15:00"
logging time: every hour, the most recent sample, i.e., instantaneous data. Enter "01:00"
conversion equation: none
min/max logging time: every 24 hours. Enter "24:00"
s*ampling start time:* current time is 13:56 and the user wants a log record at the top of every hour. Enter "14:00:00"
min/max start time: user wants min/max log record at midnight. Enter "24:00:00".

Refer to the examples in section 5.3.

4.3.2. SETUP AN ANALOG SENSOR

DO NOT MAKE ANY CONNECTIONS UNTIL YOU HAVE READ ALL OF THIS SECTION.

Analog sensors may be voltage output sensors, 4-20mA sensors, resistive devices such as RTDs. These sensors may be linear or non-linear. In either case the logger must convert the incoming data from these sensors into the desired engineering units (eg. psi, metres, kph, mb, °C, …) . In the case of linear sensors the user need only specify a *SCALE* and an *OFFSET* for proper conversion of the data. This is done when the user is prompted for a conversion equation when the sensor is being inserted into the *Sensor Log Table* (section *5.3*) . With non-linear sensors, the user must define a more complex equation such as a polynomial of higher order (4^{th}, 5^{th} or even 6^{th} order). Otherwise, both types of sensors require the same setup.

The PDAS-III logger has four analog input channels for connection to such sensors. These terminals are labeled AIN1, AIN2, AIN3, AIN4 (see Figure 7).

First determine what voltage range is required for your application. The ranges of the analog input channels for the rev E and F PDAS-III are user-configurable as follows: +/-100mV, 0-1V, 0-2.5V and 0-5V. **The user should always configure the input range PRIOR to making any connections to an analog sensor.** This is done from **Main Menu → System Setup → External A/D Channels** (see section 5.6.2, p.5-44). For voltage output sensors, the range of the input channel should be equal to or greater than that of the sensor. Therefore, a 0-5V sensor requires a 0-5V input, a 0-2Vsensor requires a 0-2.5V input.

In the case of **4-20mA SENSORS**, it is best to configure the input channel to the minimum unipolar range as per section 5.6.2 (p.5-44), that is, 0-1V. Also, refer to Figure 3 for a connection diagram.

In the case of bipolar sensors the user must select an input range of +/-100mV. For bipolar sensors with a range greater than +/-100mV the user must install appropriate attenuation resistors to reduce the input range to within +/-100mV.

Once the input channel is configured as per section 5.6.2, power-down the logger and make the sensor connections. 4-20mA sensors only two wire connections plus a shield wire. Connect the wire labeled "+ supply" (usually red) to the "+12V" for continuous power, or "+12V SW" for software-controlled power (see 4.3.4, p. 4-9). Connect the wire labeled "- supply" (usually black) to the desired channel, say #4 (terminal "AIN 4"). Connect the shield wire to "GND". Next install a termination resistor in the socket corresponding to the channel to which the sensor is connected, say "R4". The termination resistor should have a tolerance no greater than +/-1% with a value determined by Ohm's law (V=IR). Therefore, the termination resistors should be as follows:

Table 1. Proper values for termination resistors.

Range of input channel	Value of termination R
0-1 V	1V/0.020A= 50Ω
0-2.5V	125Ω
0-5V	250Ω

Once connections are complete the user may power-up the logger and set-up for sampling and logging data from the sensor. It may also be desirable to define a conversion equation in order to log data in engineering units. All of this is done by selecting **3 Sensor Log Table → 2 Add/Edit Sensor.** The PDAS-III menu system is user-friendly and guides the user through the setup sequence. To view examples of this refer to section 5.3.2.

4.3.3. SETUP A TIPPING BUCKET

Tipping buckets rain gauges, and other sensors that use switch closures, must be connected to an event counter. These sensors only have two wire connections to be made: GND and event counter. The PDAS-III loggers are equipped with two event counters (Environment Canada models may only have one). Connect to "EvCnt1" on the detachable terminal strip as shown in section 8.3, Figure 7.

NOTE: **Tipping buckets may only be connected to Event Counter #1**. Event Counter #2 dose NOT provide debouncing (high-speed pulse counting only).

Now set-up the logger to record data from the sensor using **3 Sensor Log Table → 2 Add/Edit Sensor.** When doing so the user must specify the value of each switch closure as noted on the sensor itself. Therefore, if each tip of a rain bucket equates to 0.25 mm of rain the user would enter "0.25" when prompted for the *Scale* of the event counter.

A typical logging configuration for tipping buckets would be as follows:

sampling time: 60 minutes, Enter "00:60:00"
logging time: every hour, the last sample, i.e., instantaneous data. Enter "01:00"
min/max logging time: none. Enter "00:00"
s*ampling start time:* current time is 12:56 and the user wants a log record at the top of every hour. Enter "13:00:00"

Select Log Slot 0-15
3 ← Select a slot number from 0 to 15.
---SELECT SENSOR TYPE---
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
0<CR> ← Select "Internal sensors".
---SELECT SENSOR--- _
1,2,3 or 4 Single Ended Ch#
5 Aux. (0-20)V
6 Lithium V
7 Main Pwr V
8 Internal Temp
9 Differential 1-2
10 Differential 3-4
11 Event 1 /D
12 Event 2 /D
13 PSE Encoder
14 PSE Event Cnt1
15 PSE Event Cnt2
11<CR> ← User selects the event counter to which the sensor is connected (eg. EvCnt1).
.
. Refer to section 5.3 for the remaining details.
.

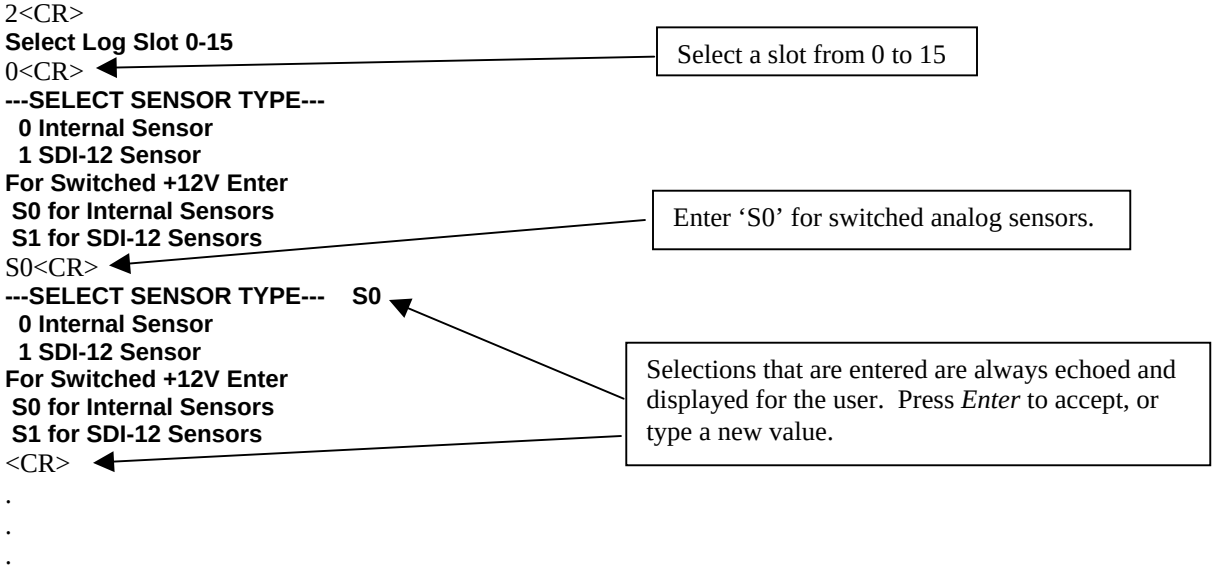
To test the sensor begin by selecting **2 View Data → 1 Instantaneous Data** (section 5.2)**.** Select the desired sensor from the list. Real-time data immediately appears on the screen. Pour water in the sensor to see the readings increment.

4.3.4. USE THE SWITCHED +12V

{Fuse "F2" on the terminal strip must be installed for the *Switched +12V* output to function. See 8.3.}
The switched +12V output is used to automatically turn sensors on and off in order to conserve power. Note that some types of sensors must not be powered on and off. For example, most shaft encoder sensors must be powered continuously in order to track water level accurately.

The switched output is labeled "+12V SW" on the detachable terminal strip (see 8.3, p. 8-10). Begin by connecting the "12V" wire of the sensor to this terminal. For 4-20mA sensors this wire is usually labeled "+ supply". In most cases this wire is red in color. All other sensor connections to the terminal strip are unchanged by using the switched output. Refer to appropriate sections of this manual for connection based on the type of sensor.

Once the connections are complete the logger must be configured for switching the power to the sensor prior to taking a sample from it. This is done when configuring the logging schedule of the sensor using **3Sensor Log Table → 2 Add/Edit Sensor.** For example, if an analog sensor is connected to the "+12V SW" the user would proceed as follows from **2 Add/Edit Sensor**:


2<CR>
Select Log Slot 0-15
0<CR>
Select a slot from 0 to 15
---SELECT SENSOR TYPE---
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
S0<CR>
Enter 'S0' for switched analog sensors.
---SELECT SENSOR TYPE--- S0
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
<CR>
Selections that are entered are always echoed and displayed for the user. Press Enter to accept, or type a new value.
.
.
.

In order to obtain reliable readings, the user must ensure that the time delay between the onset of power and the sampling of the sensor is adequate to allow for its stabilization. This time delay is user-configurable from **6 System Setup → 2 Logger Setup → 4 Sw-12V ON-Delay** (refer to 5.6 → 2 Logger Setup). The switched time delay is settable from 50 msec up to 12.75 sec.

Reference to the manual of the sensor should provide an appropriate settling time. However, one technique to establish this is to use the "block capture" function from within *Sensor Log Table* (see 5.3.1, p. 5-21). To do this proceed as follows:

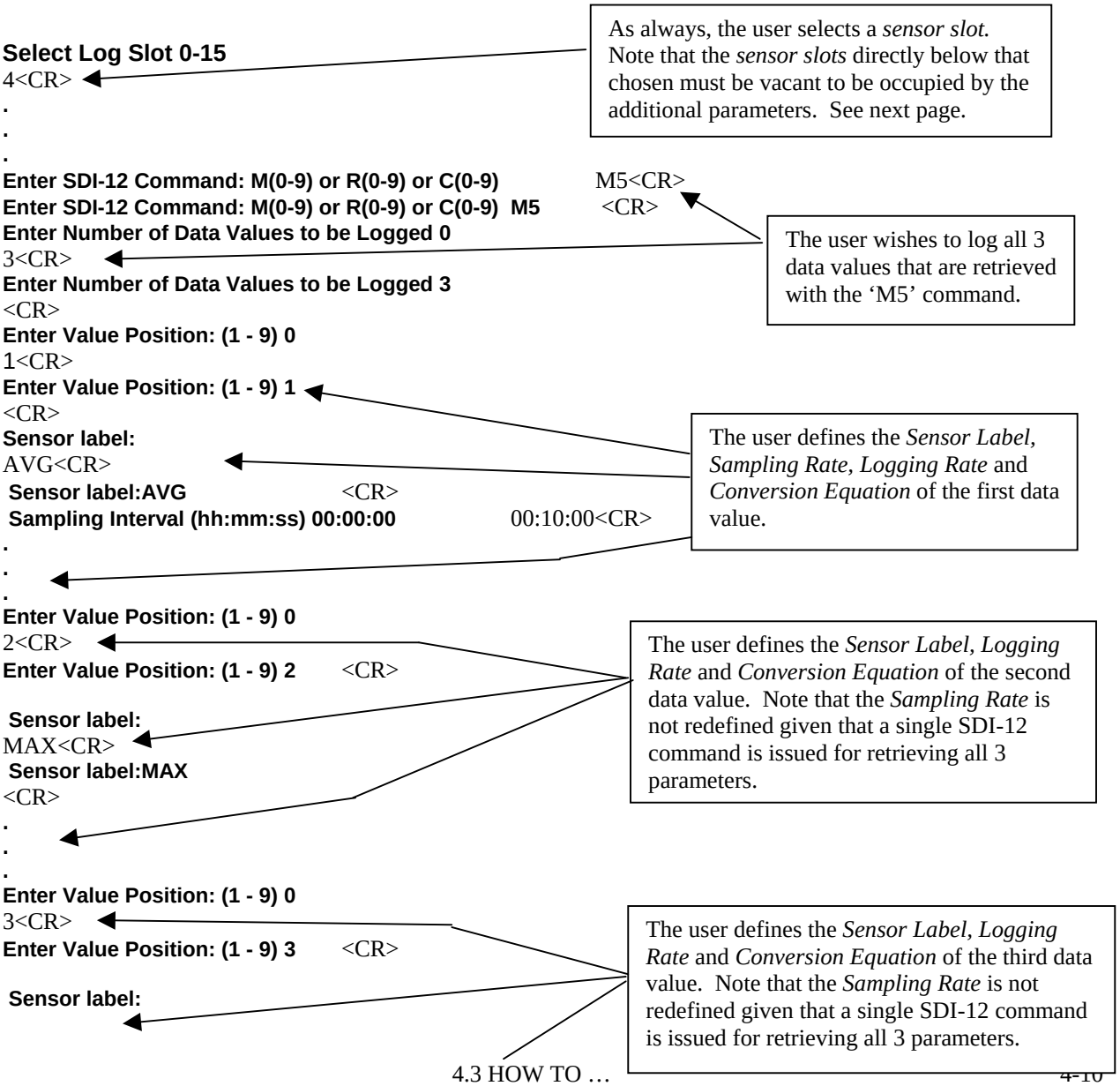
1. Set the *Sampling Rate* to 1 second (00:01). When prompted "**Select Log Data Function**", choose *Block Capture*, then for "**Number of samples**" enter '12'. *Logging Rate* and *Min/Max Rate* set to "00:00". *Start Time* one minute after the current time.
2. Wait 2 minutes.
3. Select **2 View Data → 2 Captured Block Data**, then select your sensor. The block of 12 samples is displayed. If the settling time of the sensor is between 1 and 12 seconds it will be seen here. If, for example, the data is stable after 3 seconds, set the switched 12V delay time to 3 seconds or more.

4.3.5. USE "MULTI-VALUE SDI-12 MODE"

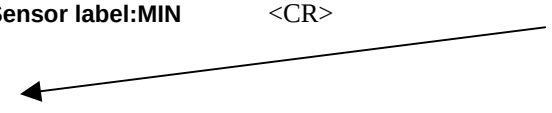
SDI-12 sensors may return up to 9 data values with a single command (latest version of SDI-12 protocol at time of printing is 1.3, see 3.2). The user may select which of these values to log by specifying the *Value Position*, as explained at the bottom of page 4-6.

However, the user may wish to log several, or even all, of the data values that are returned by a single SDI-12 command. In addition, each parameter may have a separate name ("*sensor label*"), *Logging Rate* and *Conversion Equation*. The PDAS-III provides an efficient means of doing this without having additional SDI-12 commands issued for each data value.
When configuring the PDAS to log data from an SDI-12 sensor, the user is prompted for the number of values to be logged with the single SDI-12 command. If this number is greater than "1", the PDAS will automatically be configured for "Multi" mode and make all necessary prompts as shown in the examples below.

EXAMPLE 1: For example, suppose the 'aM5!' of a SDI-12 sensor returns the "average", "minimum" and "maximum" water level readings. With a single 'aM5!' command you wish to retrieve and log the "average", "minimum" and "maximum" and have these appear in the log file with unique labels:


Select Log Slot 0-15
4<CR>
As always, the user selects a sensor slot. Note that the sensor slots directly below that chosen must be vacant to be occupied by the additional parameters. See next page.
Enter SDI-12 Command: M(0-9) or R(0-9) or C(0-9)
M5<CR>
Enter SDI-12 Command: M(0-9) or R(0-9) or C(0-9) M5
<CR>
Enter Number of Data Values to be Logged 0
3<CR>
The user wishes to log all 3 data values that are retrieved with the 'M5' command.
Enter Number of Data Values to be Logged 3
<CR>
Enter Value Position: (1 - 9) 0
1<CR>
Enter Value Position: (1 - 9) 1
<CR>
Sensor label:
AVG<CR>
Sensor label:AVG
<CR>
Sampling Interval (hh:mm:ss) 00:00:00
00:10:00<CR>
The user defines the Sensor Label, Sampling Rate, Logging Rate and Conversion Equation of the first data value.
Enter Value Position: (1 - 9) 0
2<CR>
Enter Value Position: (1 - 9) 2
<CR>
Sensor label:
MAX<CR>
Sensor label:MAX
<CR>
The user defines the Sensor Label, Logging Rate and Conversion Equation of the second data value. Note that the Sampling Rate is not redefined given that a single SDI-12 command is issued for retrieving all 3 parameters.
Enter Value Position: (1 - 9) 0
3<CR>
Enter Value Position: (1 - 9) 3
<CR>
Sensor label:
The user defines the Sensor Label, Logging Rate and Conversion Equation of the third data value. Note that the Sampling Rate is not redefined given that a single SDI-12 command is issued for retrieving all 3 parameters.

MIN<CR>
Sensor label:MIN <CR>



Current Time - 14:38:45
Enter SAMPLING Start Time (hh:mm) 00:00:00 14:40:00<CR>
Enter SAMPLING Start Time (hh:mm) 14:40:00

The configuration is complete. The PDAS-III will transmit an 'aM5!' command at 14:40:00 and log all three data values that are present in the response. The resulting *Sensor Log Table* is shown below. Note that the three desired parameters occupy adjacent *slots* in the *Sensor Log Table.*

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap/ Log	Logging Rate	Min/Max Rate	MM Time
0	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
1	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
2	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
3	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
4	0	1A0M5!/1	AVG	00:10:00	14:40:00	- I	00:10	00:00	hh:mm
5	0	mA0M5!/2	MAX	00:00:00	hh:mm:ss	- I	00:10	00:00	hh:mm
6	0	mA0M5!/3	MIN	00:00:00	hh:mm:ss	- I	00:10	00:00	hh:mm
7	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
					. . .				
15	1			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm

The meaning of the *Sensor Command* "1A0M5!/1" is as follows:

1: indicates an SDI-12 sensor occupies the slot
A0: sensor is connected to SDI-12 channel "A" and its SDI-12 address is "0". The PDAS-III has two SDI-12 channels labeled A and B.
M5!: the SDI-12 command that the PDAS-III will transmit to the sensor to retrieve the desired paramters.
/1: log the first data value in the response string.

Also,

m: indicates a slot that is linked to another as a result of a "multi-value" configuration. Here slots #5 and #6 are linked to #4.

EXAMPLE 2: The "multi" mode can also be used to perform several operations on a single value. Example 1 showed how the logger can parse multiple data that is returned with a single SDI-12 command. In this example, "multi" mode is used to sample and log SDI-12 values as well as compute and log the average and minimum/maximum of these values:

2<CR>
Select Log Slot 0-15
0<CR>
---SELECT SENSOR TYPE--- 0
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
1<CR>

Select '2 Add/Edit Sensor' from the Sensor Log Table menu (section Main Menu: SENSOR LOG TABLE). Then select a vacant slot. Note: two slots are required for this: the one you select and the one just beneath.

Enter SDI-12 Port & Address: A(0-9) or B(0-9)
A0<CR>
Enter SDI-12 Port & Address: A(0-9) or B(0-9) A0
<CR>
Enter SDI-12 Command: M(0-9) or R(0-9) or C(0-9)
M0<CR>
Enter SDI-12 Command: M(0-9) or R(0-9) or C(0-9) M0
<CR>
Enter Number of Data Values to be Logged 0
2<CR>
Enter Number of Data Values to be Logged 2
<CR>
Enter Value Position: (1 - 9) 0
1<CR>
Enter Value Position: (1 - 9) 1
<CR>
Sensor label:
HG<CR>
Sensor label:HG
<CR>
Sampling Interval (hh:mm:ss) 00:00:00
00:05:00<CR>
Sampling Interval (hh:mm:ss) 00:05:00
<CR>
Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
3<CR>
Enter Number of Samples 1 12<CR>

Logging Interval (hh:mm) 00:00
01:00<CR>
Logging Interval (hh:mm) 01:00
<CR>
MinMax Log Interval (hh:mm) 00:00
01:00<CR>
MinMax Log Interval (hh:mm) 01:00
<CR>
Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
xB - Block Functions
where x = (0,1or2)
<CR>
Current Time - 16:21:02
Enter SAMPLING Start Time (hh:mm:ss) 00:00:00
17:00:01<CR>
Current Time - 16:21:27
Enter SAMPLING Start Time (hh:mm:ss) 17:00:01
<CR>
Current Time - 16:21
Enter MinMax Start Time (hh:mm) 00:00
17:55<CR>
Current Time - 16:21
Enter MinMax Start Time (hh:mm) 17:55
<CR>

Enter the address of the sensor. Here 'A0'.

Enter the required SDI-12 command.

Enter '2' because two slots are required to log the instantaneous data, the 'max/min' and the average.

Enter '1' because we are logging the first data value returned by the command in this example.

Enter a label. Here "HG".

A sampling interval of 5 minutes was entered..

The number of samples to be logged is 12. With a sampling rate of 5 minutes and logging rate of once per hour the maximum number of samples is 12.

A logging interval of 1 hour was entered.

A Start Time of 17:00:01 was entered. The first sample will occur at that time.

A Min/Max Start Time of 17:55 was entered.

Enter '1' again for the 'value position because we are using the same data for computing the 'average'.

Enter Value Position: (1 - 9)
1<CR>
Enter Value Position: (1 - 9) 1
<CR>
Sensor label:
HG_AVE<CR>

A distinct label is specified for the 'average".

Sensor label:HG_AVE
<CR>
Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
1<CR>

Select "Block Average".

Select Log Data Function 1
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
<CR>

Since the sampling rate is 5 minutes and the logging rate is once an hour, the number of samples must be no more than 12 in this example.

Enter Number of Samples 0
12<CR>
Enter Number of Samples 12
<CR>
Logging Interval (hh:mm) 00:00
01:00<CR>
Logging Interval (hh:mm) 01:00
<CR>
MinMax Log Interval (hh:mm) 00:00
<CR>
Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
xB - Block Functions
where x = (0,1or2)
<CR>
Current Time - 16:22:09
Enter SAMPLING Start Time (hh:mm:ss) 00:00:00
17:00:01<CR>
Current Time - 16:22:17
Enter SAMPLING Start Time (hh:mm:ss) 17:00:01
<CR>

NOTE: The logger only prompts once for the sampling rate in "multi" mode.

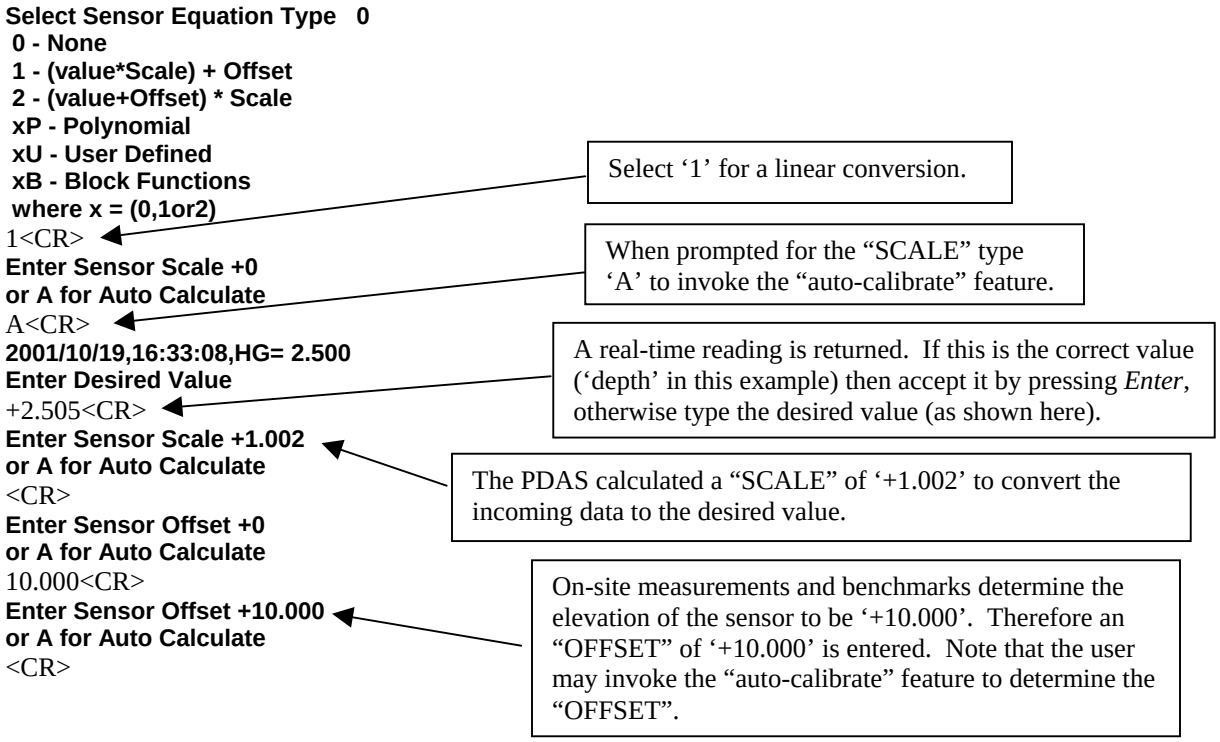
Here is the result as displayed in the Sensor Log Table:

Slot No.	Log Enable	Sensor Command	Sensor Label	Sampling Rate	Start Time	I/B Av/Cap/ Log	Logging Rate	Min/Max Rate	MM Time
0	0	1A0M0!/1	HG	00:05:00	17:00:01	- B12L	01:00	01:00	17:55
1	0	mA0M0!/1	HG_AVE	00:00:00	17:00:01	- B12A	00:00	00:00	hh:mm
2	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
.									
.									
.									
15	1			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm

4.3.6. USE THE "AUTO-CALIBRATE" FEATURE

The PDAS loggers comprise an "auto-calibrate" feature to ease the installation and calibration of linear sensors. The "auto-calibrate" feature allows the user to instruct the logger to calculate the appropriate "SCALE" and "OFFSET" to achieve user-specified values. When the "auto-calibrate" feature is invoked the PDAS queries the desired sensor for a real-time reading. The user has the option of accepting this reading or entering the desired value. If a new value is entered the "auto-calibrate" feature determines the appropriate "SCALE" or "OFFSET" to achieve this reading.

For example, suppose a new installation of a pressure transducer water level sensor is taking place. The sensor is lowered to a known depth from the surface. Then configure the logger for sampling and logging this sensor (described in detail in section 5.3 Main Menu: SENSOR LOG TABLE, also see 4.3.1, 4.3.2) using **Sensor Log Table → Add/Edit.** When prompted for a "*Sensor Equation Type*" select **1 - (value*Scale) + Offset** then proceed as shown below:


Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
xB - Block Functions
where x = (0,1or2)
1<CR>
Select '1' for a linear conversion.
Enter Sensor Scale +0
or A for Auto Calculate
A<CR>
When prompted for the "SCALE" type 'A' to invoke the "auto-calibrate" feature.
2001/10/19,16:33:08,HG= 2.500
Enter Desired Value
+2.505<CR>
A real-time reading is returned. If this is the correct value ('depth' in this example) then accept it by pressing *Enter*, otherwise type the desired value (as shown here).
Enter Sensor Scale +1.002
or A for Auto Calculate
<CR>
The PDAS calculated a "SCALE" of '+1.002' to convert the incoming data to the desired value.
Enter Sensor Offset +0
or A for Auto Calculate
10.000<CR>
Enter Sensor Offset +10.000
or A for Auto Calculate
<CR>
On-site measurements and benchmarks determine the elevation of the sensor to be '+10.000'. Therefore an "OFFSET" of '+10.000' is entered. Note that the user may invoke the "auto-calibrate" feature to determine the "OFFSET".

4.3.7. SETUP A WIND DIRECTION SENSOR

The PDAS has built-in conversion equations and functions that are specific to certain types of sensors. Functions can be added that are specific to your sensor by contacting AMASS Data Technologies at sales@amassdata.com

The PDAS provides the following built-in functions for wind direction sensors:

- **Conversion of analog signal to a wind direction expressed in units of degrees ° (applicable to potentiometer-type sensors).**
- **Vector averaging of the data if the average wind direction is desired (all wind direction sensors).**

Example: Consider a potentiometer-type wind direction sensor to be connected to the PDAS. You wish to take 24 samples, 5 seconds apart, beginning at the 58 minute-mark and ending at the top of the hour, then log the average wind direction of this block of data (see section 5.3.1) every hour.

These sensors require three connections: Ground, a voltage reference and the sensor output (voltage proportional to the wind direction). The PDAS provides voltage references of 2.5V and 5V. For this example we shall use a voltage reference of 2.5V. The range of the analog input that is to be used for this sensor should match the voltage reference in use, in this case, 2.5V. Therefore, PRIOR TO CONNECTING THE SENSOR, **configure the analog input as follows:**

MAIN MENU → SYSTEM SETUP → SENSOR SETUP → EXTERNAL A/D CHANNELS.

1<CR>
--SELECT A/D Channel---
1,2,3 or 4 Single Ended Ch#
5 Differential 1-2
6 Differential 3-4
1<CR>

Select an unused channel: 1, 2, 3 or 4. Channel 1 was selected here.

--SELECT INPUT RANGE---
1 +/-100mV
2 0-1V
3 0-2.5V
4 0-5V
3<CR>

Configure the range to 0-2.5V because the 2.5V voltage reference is being used in this example.

---SELECT OUTPUT FORMAT---
1 (0-1.0000)
2 (0-2.500)
3 (0-5.000)
4 (+/-5.000)
5 Binary Count
6 4ma Offset Correction
7 Temperature AD34
8 Wind Direction
8<CR>

The 0 to 2.5V signal is to be converted to a wind direction in units of degrees (°).

Custom Equation Required?
0 No
1 Yes
0<CR>

Select "No" because no further conversion is necessary.

NOW connect the sensor (see 8.3):

- Ground wire to the terminal labeled "AGND"
- Voltage reference wire to the terminal labeled "2.5V ref"
- Output wire to the terminal labeled "AIN 1"

Now, configure the PDAS for logging the data. Do this as follows:

MAIN MENU → SENSOR LOG TABLE → ADD/EDIT SENSOR

Select Log Slot 0-15
4<CR>

Select an unused slot. Eg. 4

---SELECT SENSOR TYPE---
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
0<CR>

Select "Internal sensors".

---SELECT SENSOR--- _
1,2,3 or 4 Single Ended Ch#
5 Aux. (0-20)V
6 Lithium V
7 Main Pwr V
8 Internal Temp
9 Differential 1-2
10 Differential 3-4
11 Event 1 /D
12 Event 2 /D
13 PSE Encoder
14 PSE Event Cnt1
15 PSE Event Cnt2
1<CR>

Select the channel to which the sensor is connected: 1

.
. Refer to section 5.3 for these details.
.

Sampling Interval (hh:mm:ss) 00:00:00 00:00:05<CR>
Sampling Interval (hh:mm:ss) 00:00:05 <CR>
Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
1/wd<CR>

Select "Block Average, wind direction".

Select Log Data Function 1/wd
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
<CR>
Enter Number of Samples 00
24<CR>

Specify 24 samples.

Enter Number of Samples 24
<CR>
Logging Interval (hh:mm) 01:00<CR>
MinMax Log Interval (hh:mm) 00:00 <CR>

Specify to log once an hour. The log will occur at the top of every hour because sampling begins at the 58 minute-mark and lasts for two minutes.

Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
0<CR>

Default is for no conversion equation.

Current Time - 12:32:00
Enter SAMPLING Start Time (hh:mm:ss) 00:00:00
12:58:00 <CR>

The ***Start Time*** determines when the first sample occurs: 12:58:00, and every hour thereafter.

4.3.8. SETUP A WIND SPEED SENSOR

One of the most common types of wind speed sensors is one that generates a sine wave as a result of a rotating propeller. The frequency and amplitude of the signal are linearly proportional to the wind speed. Such wind speed sensors may be connected to PDAS-III loggers via a sine-wave to square-pulse conversion module (inquire at sales@amassdata.com). The sine wave output of the sensor is connected to the conversion module. The square wave output of the conversion module is connected to Event Counter 2 of the PDAS-III (labeled "EvCnt2" on the terminal strip).

NOTE: Wind speed sensors must be connected to Event Counter 2 of the PDAS-III logger. Event Counter 1 does not support this type of installation, only switch closure-type sensors (ex. Tipping buckets).

EXAMPLE: A wind speed sensor as described above is to be connected to the PDAS-III logger. The AMASS Data PSWSP sine-wave to square-pulse conversion module is required. Begin by making the required connections (refer to the sensor manufacturer's manual):

Wind speed sensor	PSWSP	PDAS-III
Sine wave output	Blue wire	
	White	Event Counter 2
Ground wire	Black	Ground terminal
	Red	+12V terminal

Now determine how to convert the incoming pulses on Event Counter 2 to wind speed in engineering units such as metres/second. Refer to the manual of the sensor for the conversion equation that is required. In this example, the manufacturer states that a signal of 90Hz is equivalent to 8.8m/s. The calculation for determining the conversion is shown below.

Suppose you wish to sample every 5 seconds for an interval of 2 minutes, that is, 24 samples, from the 58 minute-mark up to the top of the hour. The logger is to log the average of the 24 samples. The conversion of pulses to wind speed in metres/second is thus

$$\textbf{SCALE} = \left(\frac{1}{5 \text{ seconds}}\right)\left(\frac{8.8 \text{ metres/second}}{90 \text{ Hz}}\right) = \textbf{0.0196}\ \frac{\textbf{metre}}{\textbf{second x pulse}}$$

Note that the above conversion number is only valid for a sampling rate of 5 seconds. The first multiplier above of 1/5 sec is to convert the total number of pulses over the 5 second interval into pulses/second, that is, units of Hz.

Now proceed to configure the logger to perform the desired data collection:

MAIN MENU → SENSOR LOG TABLE → ADD/EDIT SENSOR

Select Log Slot 0-15
3<CR>
---SELECT SENSOR TYPE--- 0
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
0<CR>

---SELECT SENSOR---
1,2,3 or 4 Single Ended Ch#
5 Aux. (0-20)V
6 Lithium V
7 Main Pwr V
8 Internal Temp
9 Differential 1-2
10 Differential 3-4
11 Event 1 /D

12 Event 2 /D

12/D<CR>

Enter this as shown. The '/D' is required to log the difference between the current count and the previous count, rather than cumulative number of counts.

.
. Refer to section 5.3 for these details.
.

Sensor label: US<CR>
Sampling Interval (hh:mm:ss) 00:00:05 <CR>

Select Log Data Function 1
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
1<CR>

Enter Number of Samples 24<CR>
Logging Interval (hh:mm) 01:00 <CR>
MinMax Log Interval (hh:mm) 00:00 <CR>

Select Sensor Equation Type
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
xB - Block Functions
where x = (0,1or2)
1<CR>
Enter Sensor Scale
or A for Auto Calculate
+0.0196<CR>
Enter Sensor Offset
or A for Auto Calculate
+0.000<CR>
Current Time - 12:36:17
Enter SAMPLING Start Time (hh:mm:ss) 12:58:00 <CR>

It's complete.

Use **VIEW DATA** (section 5.2) to see the wind speed in real-time. The **View Data** facility supports the differential mode of Event Counter 2 so that frequency-type measurements such as described here may be viewed in real-time.

5. MENU TREE REFERENCE

ALL PDAS loggers have a user-friendly built-in menu system for configuration and retrieval of data. When using the menu system the following characters may be used to ease the operation of the PDAS.

Table 2. Special characters for use with (rev E and later) PDAS loggers.

Character	Action
<BACKSPACE>	The usual function, that is, deletes the previous character. Multiple <BACKSPACE> characters may be used.
<ESC>	Return to the next highest menu in the hierarchy. The <ESC> character is ineffective if the user is currently executing a menu selection such as adding a sensor to the *Sensor Log Table.*
<CTRL-Z>	This escape sequence is used to interrupt the downloading of data.
<CTRL-C>	Resets the communications status of both the *GOES/modem* port and the *Programming* port to a receive state. The <CTRL-C> escape sequence may be used from either of these ports. <CTRL-C> is used to recover from a communications breakdown if the logger is non-responsive because one of the ports is in a transmit loop.

The PDAS uses a password protection system for safeguarding the unit from intruders. This system comprises two levels of access entitled "ENTRY" and "PROGRAM". Assuming the user has set-up a dumb terminal emulator as explained in section 4.1 Getting Started (or is using a communications program such as *PROCOMM*), he/she may then initiate the menu[1] by simply pressing the "enter" key and entering the correct "ENTRY" password. The default "ENTRY" password is "AMASSER" (yes, it is case-sensitive). Failure to enter the correct password will prevent entry into the menu system as follows (the bold lettering represents the program's output whereas the regular font represents the user's input):

ENTRY password please:
Colombo<CR>
ENTRY password please:
amaa<BACKSPACE>sser<CR>
ENTRY password please:
AMASSER<CR>

After entering the correct "ENTRY" password, introductory information is displayed after which the Main Menu appears.

The Main Menu is as follows for modem-based units…

AMASS Data Technologies PDAS-II/MDM E350
Firmware(c)William P.Thomas 1996-99/2000-01
DATE: 2006/12/12
TIME: 15:15:41
UNIT ID NO: T35947857511030
SITE DESCRIPTION: Bills Hobbit Hole

[1] Refer to "7 DIRECT COMMUNICATIONS COMMANDS" for non-menu based operation.

-------- MAIN MENU --------
1 SET DATE & TIME
2 VIEW DATA
3 SENSOR LOG TABLE
4 LOG FILE RETRIEVAL
5 SENSOR ALARM TABLE
6 SYSTEM SETUP
7 exit

… OR as follows for GOES-based units:

AMASS Data Technologies Inc. PDAS/CS HDR E303
Firmware (c)William P.Thomas 1996,97,98,99

GOES Address: 7770175e
UNIT ID NO: T35947857511030
SITE DESCRIPTION: Bills Hobbit Hole
DATE: 2006/12/13
2006/12/12<CR>
DATE: 2006/12/12
<CR>
TIME: 11:42:10
11:38:02<CR>
TIME: 11:38:02
<CR>
GMT Offset (hh:mm) 05:00
<CR>
GMT Time: --HDR GPS Sync--

The user can make changes to the date, time and GMT offset upon entering the menu (GOES-based units only).

A GPS time fix is pending.

---MAIN MENU---
1 CS-HDR GOES SETUP
2 VIEW DATA
3 SENSOR LOG TABLE
4 RETRIEVE LOGGED DATA
5 SENSOR ALARM TABLE
6 SYSTEM SETUP
7 exit

NOTE: The user has the option of disabling the *ENTRY* level password by setting it to a single spacebar character. The passwords are set from the *SYSTEM SETUP* submenu (see 5.6).

The only options available to the user at this point are items '2' and '4'. The other options are only accessible once the "PROGRAM" password is entered as such:

Enter PROGRAM Password -
MODIFY

Note that the default password in this case is "MODIFY". The "PROGRAM" password gives the user unrestricted access with respect to configuring or modifying any parameters whereas the "ENTRY" password enables only viewing and downloading of the log file. In order to terminate the higher level of access (PROGRAM), the user must select '7 - exit' from the main menu. The "ENTRY" password may then be reentered in order to proceed with viewing or downloading data.

Note that to change the password the user must select item '6' as described in 5.6 Main Menu: SYSTEM SETUP.

Each of the options of the Main Menu presents a sub-menu to perform desired actions which are described in more detail in the following sections.

⇒ Item **1 SET DATE & TIME** allows the user to set the date and time of the logger for modem-based units (section 5.1 Main Menu: SET DATE AND TIME). For loggers with GOES (option "/HDR"), this menu item appears as **1 CS-HDR GOES SETUP** for configuring the GOES system (sections 5.1.1).

⇒ With item **2 VIEW DATA** the user can view the instantaneous value of sensor data in real-time. For example, the instantaneous shaft position of an encoder or the current internal temperature may be displayed (section 5.2).

⇒ Item **3 SENSOR LOG TABLE** is used to setup the logging schedules: assigning sensors to log slots, setting sampling rates and time intervals for both log entries and min/max entries (section 5.3).

⇒ Item **4 LOG FILE RETRIEVAL** allows the user to retrieve records from the log file based either on the number to be retrieved or the date of the oldest record (section 5.4).

⇒ Item **5 SENSOR ALARM TABLE** is used to configure alarms (section 5.5).

⇒ Item **6 SYSTEM SETUP** is for configuration of the Analog Input Subsystem and miscellaneous functions such as setting the passwords (section 5.6).

The menu system also features a communications watchdog. The watchdog provides added security in the event that a user forgets to properly exit the menu system. It uses a delay of about 7 minutes so that the user is automatically exited from the menu if he/she has not made an entry in that period of time.

5.1. Main Menu: SET DATE AND TIME

This selection requires PROGRAM-password clearance (see section 5 MENU TREE REFERENCE).

When the menu is initiated, the introduction displays the product name and author as well as the current date and time, unit ID number, site description as well as GMT time and GOES platform address for units equipped with GOES support (see below). This information is stored in the RAM which is safeguarded by the Lithium battery. The user may alter these parameters (except for the product name and author of course) by selecting item **1 SET DATE AND TIME** of the main menu. Doing this prompts the user for a new entry by displaying the current value of each parameter in turn. You may respond by typing a new value or by simply pressing the "enter" key to leave the current value unchanged.

⇒ For example, if the date and time are to be set the user would select **1 SET DATE AND TIME** from the Main Menu and interact in the following manner:

DATE: 1997/06/03
1997/06/04<CR>
DATE: 1997/06/04 <CR>
TIME: 11:42:34
11:43:34<CR>
TIME: 11:43:34 <CR>

Where '<CR>' is the "enter" key. Note that changes are confirmed by "echoing" the new value (the bold lettering represents the program's output whereas the regular font represents the user's input). Values that are to be left unchanged are not "echoed" once you press the "enter" key.

⇒ FOR LOGGERS EQUIPPED WITH GOES SUPPORT, selection 1 appears as **1 GOES HDR SETUP** (see section 5.1.1). All setup of the GOES transmitter is accomplished from this selection.

Setting the date and time with the GOES-based units (option "/HDR") is usually accomplished via **1GOES HDR SETUP → 0 Initialization** (refer to section 5.1.1.1). However, the PDAS-III does provide a means of setting the time manually (see section 5 above) prior to getting a GPS fix. This is done prior to entering the Main Menu as follows:

NOTE that although the time may be set manually the SAT HDR must obtain a GPS fix prior to transmitting for the first time after power-up. The PDAS clock will synchronize to the SAT HDR clock one minute after each transmission. The preferred method of setting the time is to wait for a GPS fix and synchronize the PDAS clock to the SAT HDR clock as described in section 5.1.1.1.

5.1.1. Main Menu: GOES CSHDR SETUP

For models with GOES support for the CS SAT HDR transmitter, the *GOES CSHDR SETUP* submenu allows the user to initialize as well as diagnose the GOES system. All configurations of the GOES system are performed as described below.

NOTE: When initially powering-up the SAT HDR the status LED will display various colors in turn. During this time the SAT HDR is either initializing or establishing a GPS fix. Please see section 8.2.2 /HDR Models or the SAT HDR manual for details.

By selecting item **1 GOES CSHDR SETUP** from the Main Menu, the user is presented with options with respect to configuring or viewing the current set-up of the GOES system connected to the *GOES/Modem Port*:

1<CR>
---GOES Transmitter CS-HDR--
0 Initialization
1 Diagnostics
2 Enable Transmitter
3 GOES Data Collection - Disabled
4 Edit GOES Log Functions
5 Display GOES Log Table
6 Xmit Random Message
M Main Menu

To set-up the PDAS and SAT HDR transmitter for GOES transmissions use **0 Initialization**. While doing so, however, the transmitter is disabled from making transmissions. It is important therefore to rearm the transmitter (using selection **2 enable Transmitter**) following its initialization. The user should also verify the operational status of the transmitter following the initialization with **1 Diagnostics** (refer to section *5.1.1.2* DIAGNOSTICS).

NOTE: The PDAS-III incorporated changes over previous versions with respect to enabling/disabling GOES transmissions. As before, the user must "Enable Transmitter" after loading a new configuration into it via the "Initialization" submenu (5.1.1.1). However, once this is done the transmissions will remain enabled **EVEN DURING A POWER RESET.** Therefore, if the transmitter is configured ("Initialization" submenu), the system can be powered-down, shipped, and powered-up again where transmissions will recommence. Note that it will only recommence once the transmitter has obtained a GPS fix. The only way to DISABLE GOES transmissions is either to toggle to the 'Disabled' state using **3 Goes Data Collection Disabled**, or by reconfiguring the transmitter from the initialization submenu.

When configuring the PDAS logger and accompanying transmitter recall that the user can return to the previous menu using the <ESC> key. For example,

---GOES INITIALIZATION
0 Set Date & GMT Offset
1 Set GOES Platform Address
2 Self-timed Mode
3 Random Mode
M Main Menu

GOES Initialization Menu

<ESC><CR>

---GOES Transmitter CS-HDR--
0 Initialization
1 Diagnostics
2 Enable Transmitter
3 Goes Data Collection Disabled
4 Edit GOES Log Functions
5 Display GOES Log Table
6 Xmit Random Message
M Main Menu

GOES Main Menu

Current status of GOES transmissions: Disabled. (See section 5.1.1.1)

The *GOES Main Menu* also allows the user to enable/disable certain acquisitions from being transmitted by parameter, and by occurrence. For instance, say parameters 'WV', 'WV4' and 'WV5' are being logged at 15-minute intervals. You may opt to:

1. transmit all data from 'WV',
2. not transmit ANY data from 'WV4' and
3. only transmit every other data for 'WV5' (30 minute interval).

This is accomplished from the "GOES Log Table" (selection **5 Display GOES Log Table** from the *GOES Main Menu*) and a parameter called "**LOG/GOES RATIO**". It allows for better management of the outgoing data, particularly in instances when the amount of data would otherwise surpass the constraints of the transmission window. The user can also individually enable/disable min/max acquisitions.

Note that all data, whether selected for GOES telemetry or not, is logged to the on-board log file.

The GOES LOG TABLE also serves to select to which of the two transmitter buffers the data is to be loaded: Self-Timed or Random. Data that is loaded into the Self-Timed and Random buffers will be transmitted as per the current configuration of these two transmission modes (see 5.1.1.2 DIAGNOSTICS)

⇒ Item '**5 Display GOES Log Table**' displays the current set-up for the GOES telemetry of logged data. For example,

3<CR>

Slot No.	Log Enable	Sensor Command	Sensor Label	Log/GOES Ratio	MIN/MAX Data	BUFFER Selection	Redundant Mode
0	1	1A1M0! /1	HG	01	Enabled	Self-timed	Disabled
1	0	07	VB	04	Enabled	Self-timed	Disabled
				.			
				.			
				.			
15	0			Disable	Enabled	Self-timed	Disabled

Each column is defined as follows:

Slot No.: Each row of the table is known as a slot. They are numbered from 1 to 15. Refer to 5.3.

Log Enable: Value is either '0' or '1' to indicate whether the parameter configured in that slot (row) is currently being sampled and logged. Refer to *Start Time* in section 5.3.

Sensor Command and Label: This is the user-specified command string for polling the sensor as well as its corresponding label. This configuration of the logger is accomplished from the *Sensor Log Table* menu. Refer to section 5.3.

LOG/GOES RATIO: The *LOG/GOES RATIO* determines whether GOES telemetry is enabled for the parameter in that slot, as well as the frequency as a function of the *Logging Rate* (see section 5.3). For instance, a *LOG/GOES RATIO* of '01' indicates that every acquisition that is logged is also transmitted via GOES. A *LOG/GOES RATIO* of '04' indicates that every fourth acquisition that is logged is transmitted via GOES.

This value is '1' by default. It must be set within the range of 1 to 255 to enable GOES transmissions of the parameter in that slot. To disable it, set the *LOG/GOES RATIO* to 0.

In the example above, HG has a *LOG/GOES RATIO* of 1whereas that for VB is 4. Therefore, if the *Logging Rate* for both parameters is 15 minutes, the only data transmitted for VB will be hourly readings.

MIN/MAX Data: Min/Max data can be transmitted or not: "Enabled" or "Disabled".

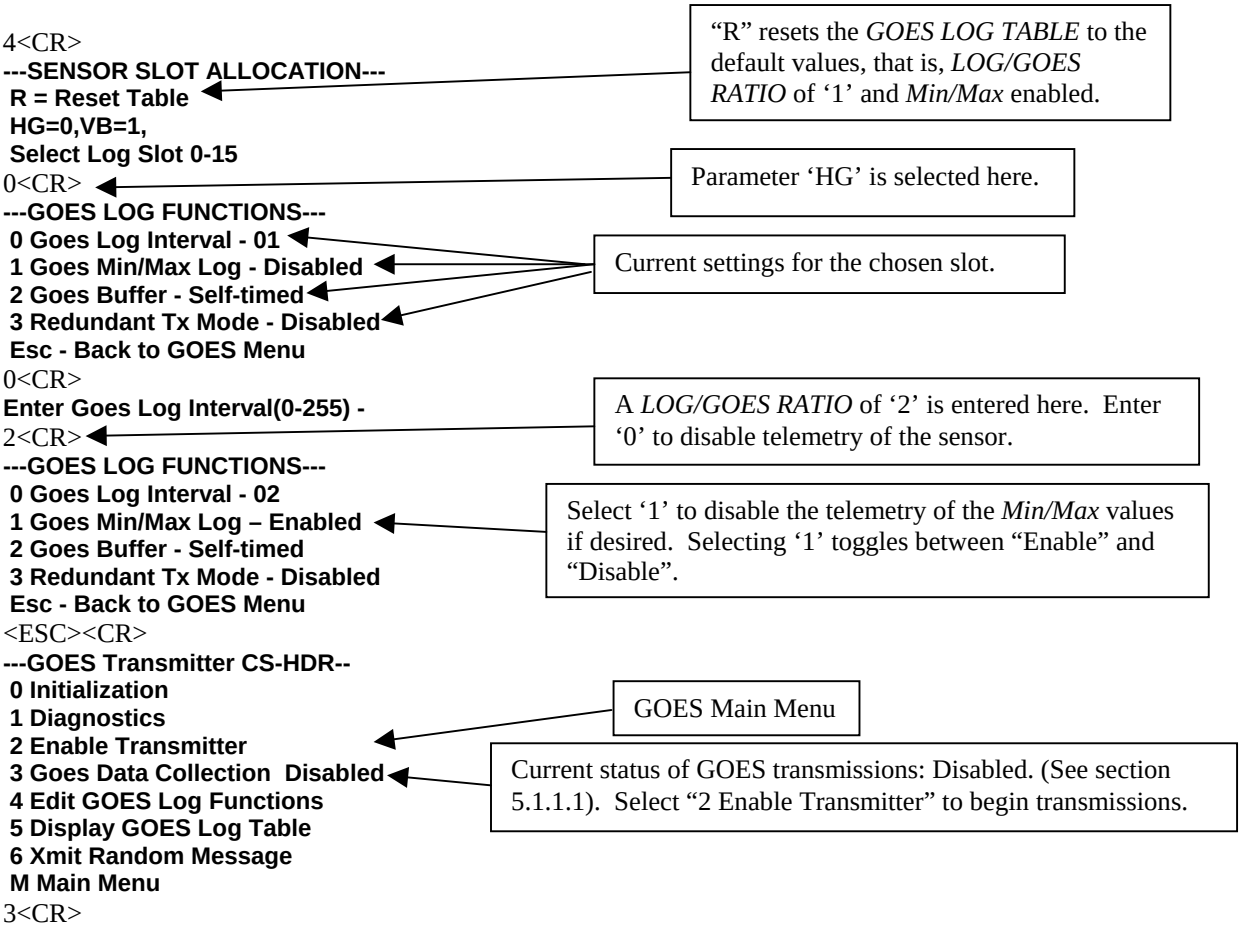
Redundant Mode: By default "redundant" mode is disabled. "Redundant" mode transmits data that was logged in the current transmit interval as well as the last. This can be used as a means of recovering data from corrupt or incomplete transmissions.

Note that each parameter has individual control with respect to GOES telemetry. Furthermore, this control applies to the Min/Max and the instantaneous data of each parameter separately.

By default all data is to be loaded into the Self-Timed buffer. "Random" mode transmissions are accomplished through the use of the alarms as per section 5.5 Main Menu: SENSOR ALARM TABLE. Once the alarms are configured, data may be loaded into the Random buffer of the SAT HDR if the user-specified conditions are met.

In the example above, the logged data as well as the Min/Max data of both 'HG' and 'VB' will be output via GOES telemetry.

⇒ Item ' **4 Edit GOES Log Functions'** allows the user to make changes to the *GOES Log Table*. For example, assume the user wishes to transmit only every second data value that is logged for HG:


4<CR>
---SENSOR SLOT ALLOCATION---
R = Reset Table
HG=0,VB=1,
Select Log Slot 0-15
0<CR>
---GOES LOG FUNCTIONS---
0 Goes Log Interval - 01
1 Goes Min/Max Log - Disabled
2 Goes Buffer - Self-timed
3 Redundant Tx Mode - Disabled
Esc - Back to GOES Menu
0<CR>
Enter Goes Log Interval(0-255) -
2<CR>
---GOES LOG FUNCTIONS---
0 Goes Log Interval - 02
1 Goes Min/Max Log – Enabled
2 Goes Buffer - Self-timed
3 Redundant Tx Mode - Disabled
Esc - Back to GOES Menu
<ESC><CR>
---GOES Transmitter CS-HDR--
0 Initialization
1 Diagnostics
2 Enable Transmitter
3 Goes Data Collection Disabled
4 Edit GOES Log Functions
5 Display GOES Log Table
6 Xmit Random Message
M Main Menu
3<CR>
"R" resets the GOES LOG TABLE to the default values, that is, LOG/GOES RATIO of '1' and Min/Max enabled.
Parameter 'HG' is selected here.
Current settings for the chosen slot.
A LOG/GOES RATIO of '2' is entered here. Enter '0' to disable telemetry of the sensor.
Select '1' to disable the telemetry of the Min/Max values if desired. Selecting '1' toggles between "Enable" and "Disable".
GOES Main Menu
Current status of GOES transmissions: Disabled. (See section 5.1.1.1). Select "2 Enable Transmitter" to begin transmissions.

Slot No.	Log Enable	Sensor Command	Sensor Label	Log/GOES Ratio	MIN/MAX Data	BUFFER Selection	Redundant Mode
0	1	1A1M0! /1	HG	02	Enabled	Self-timed	Disabled
1	0	07	VB	04	Enabled	Self-timed	Disabled
				.			
				.			
				.			
15	0			01	Enabled	Self-timed	Disabled

5.1.1.1. INITIALIZATION

What follows is an example of an initialization of the GOES SAT HDR transmitter in **SELF-TIMED MODE** with the following parameters:

- GOES platform address: 48161450
- Transmission channel: 9
- Transmission interval: 3 hours
- Transmission offset time: 57 minutes past midnight GMT
- Transmission window length: 60 seconds
- Satellite link parameter: Short link preamble, Long link interleaver
- Greenwich Mean Time Offset: 4 hours (eg. transmissions from Québec on EDT)

0<CR> {GOES Initialization}

NOTE - ALL TRANSMISSIONS WILL BE DISABLED!!
Press Enter to Continue! ESC to go back!
<CR>
---GOES INITIALIZATION
0 Set Date & GMT Offset
1 Set GOES Platform Address
2 Self-timed Mode
3 Random Mode
M Main Menu

⇒ 2<CR>
Select Bit Rate 1
1 100
2 300
3 1200
<CR>

Select the desired bit rate. Here the default of 100 baud has been accepted.

Enter Self-Timed Xmtr Channel No. (1- 266) 9<CR>

Enter Self-Timed Tx Interval (dd:hh:mm:ss) 00:03:00:00 <CR>

Enter GMT Offset (hh:mm) 04:00 <CR>

Enter Transmission Offset Time (hh:mm:ss) 00:57:00 <CR>

Enter Window Length (1-120 sec.) 60 <CR>

Enter Link Preamble 1
0 Long
1 Short
<CR>

Enter Link Interleaver 1
0 None
1 Long
2 Short
<CR>

---GOES INITIALIZATION
0 Set Date & GMT Offset
1 Set GOES Platform Address
2 Self-timed Mode
3 Random Mode
M Main Menu

⇒ The date and time is set from **0 Set Date & GMT Offset** of the Initialization menu. For example:
0<CR>
DATE: 1999/03/03
1999/03/08<CR>
DATE: 1999/03/08
<CR>
Enter GMT Offset (hh:mm) 05:00
04:00<CR>
Enter GMT Offset (hh:mm) 04:00
<CR>
GMT Time: 14:53:12
RTC Time: 10:53:12
Enter RTC Time (hh:mm:ss)
10:54:05<CR>
GMT Time: 14:54:05
RTC Time: 10:54:05
Enter RTC Time (hh:mm:ss)
<CR>
Press Enter to start GOES Clock
<CR>

The Seimac SAT HDR transmitter synchronizes its GPS clock approximately 20 seconds prior to transmission. The PDAS-III synchronizes its clock with that of the SAT HDR transmitter following every transmission, that is, immediately after the expiration of the transmission window.

⇒ The GOES platform address is set with **1 Set GOES Platform Address** of the Initialization menu:

1<CR>
Enter GOES Platform Address (8 hex digits) 34383136
48161450<CR>
Enter GOES Platform Address (8 hex digits) 48161450
<CR>

The transmitter must now **be rearmed in order for transmissions to take place.** This is done with **2 Enable Transmitter** from the GOES Main Menu. In addition, the user would normally select **1 Diagnostics** from the GOES main menu in order to establish the status of the transmitter set-up. Please refer to 5.1.1.2 DIAGNOSTICS.

---GOES Transmitter CS-HDR--
0 Initialization
1 Diagnostics
2 Enable Transmitter
3 Goes Data Collection Disabled
4 Edit GOES Log Functions
5 Display GOES Log Table
6 Xmit Random Message
M Main Menu

GOES Main Menu

Current status of GOES transmissions: Disabled. (See section 5.1.1.1). Select "2 Enable Transmitter" to begin transmissions.

What follows is an example of an initialization of the GOES SAT HDR transmitter in **RANDOM MODE** with the following parameters:

- Transmission channel: 9
- Random interval: 20 minutes.
- Satellite link parameter: Short Link Interleaver

NOTE: Data that is to be transmitted in Random Mode must be so configured using **5 Display GOES Log Table** from the *GOES Main Menu* as per section 5.1.1.

0<CR> {GOES Initialization}
NOTE - ALL TRANSMISSIONS WILL BE DISABLED!!
Press Enter to Continue! ESC to go back!
<CR>
---GOES INITIALIZATION
0 Set Date & GMT Offset
1 Set GOES Platform Address
2 Self-timed Mode
3 Random Mode
M Main Menu

⇒ 3<CR>
Select Bit Rate 1
1 100
2 300
3 1200
<CR>

Select the desired bit rate. Here the default of 100 baud has been accepted.

Enter Random Xmtr Channel No. (1- 266) 09 <CR>

Enter Random Transmit Interval (hh:mm:ss) 00:20:00 <CR>

Enter Link Interleaver 2
0 None
1 Long
2 Short
<CR>

---GOES INITIALIZATION
0 Set Date & GMT Offset
1 Set GOES Platform Address
2 Self-timed Mode
3 Random Mode
M Main Menu

The user must ensure that the GOES platform address and that the date and time are correct.

NOTE that the transmitter **must now be rearmed in order for transmissions to take place.** This is done with **2 Enable Transmitter.** In addition, the user would normally select **1 Diagnostics** from the GOES Main Menu in order to establish the status of the transmitter set-up. Please refer 5.1.1.2 DIAGNOSTICS.

5.1.1.2. DIAGNOSTICS

The diagnostics capability of the PDAS is described here and represents the full extent of information that is accessible via the "Aux. Port" of the SAT HDR. Direct communication with the SAT HDR is accomplished with the DCPCOMM software that is provided with the unit. This not only allows for full diagnostics of the transmitter but also to load new Operating Systems and configuration files via the "SAT HDR Config Port" (seeFigure 5. PDAS-III with /PSE/D and /HDR options.).

From the GOES main menu, the user selects **1 Diagnostics** in order to establish if the transmitter is set-up as desired and that transmissions will take place as intended. As explained previously, the "GOES main menu" is obtained from the Main Menu by selecting **1 GOES CS HDR Setup** as follows:

1<CR>
---GOES Transmitter CS-HDR--
0 Initialization
1 Diagnostics
2 Enable Transmitter
3 Display GOES Log Table
4 Edit GOES Log Functions
5 Xmit Random Message
M Main Menu

GOES Main Menu

⇒ 1<CR>
---GOES DIAGNOSTICS---
0 Current Configuration
1 Current GOES Time (hh:mm:ss)
2 Current Status
3 Last Message Status
4 Insert String to GOES Buffer
5 Error Status
6 Reset Error Counter
M Main Menu

GOES Diagnostics Menu

The user is thus presented with choices that enable a complete diagnostics of the GOES.

⇒ Use **0 Current Configuration** to display the GOES set-up as follows:

0<CR>
GOES Address: 48161450
Self-Tmd Channel 9 @ 100
Tx Interval 00:03:00:00
Offset Time 00:57:00
Tx Window (sec)60
Short Pre- Long Int
Random Channel 9 @ 100
Tx Interval 00:20:00
- Short Int

If the above is different from the intended configuration select **0 Initialization** to make any necessary changes.

⇒ Select **1 Current GOES Time (hh:mm:ss)** as follows:

1<CR>
GMT Time 12:09:00
RTC Time 08:09:00

<CR>

Note that the PDAS-III clock is synchronized to the GOES transmitter clock one minute following every transmission. The transmitter itself uses a GPS clock.

⇒ Select **2 Current Status** as follows:

2<CR>
Goes Data Collection Online

--Self-Timed Status--
Time to Next Xmt 00:00:17:52 00:19
Buf Size 0
Self-timed

--Random Status--
Time to Next Xmt 153:153:153
Buf Size 0
Random

GPS AcqTm 02
Failsafe Disabled

Note the following:

1. **Goes Data Collection** is currently "online". This indicates that the PDAS-III will load data into the SAT HDR for transmission. If **Goes Data Collection** is "offline" transmissions will be disabled because data will not be transffered to the SAT HDR buffer. NOTE: data is always logged regardless of whether **Goes Data Collection** is "online" or "off-line".
2. The next self-timed transmission will take place in 0 hours, 17 minutes and 52 seconds.
3. "**153:153:153**" indicates that the Random Mode is disabled and is thus not scheduled to transmit. As per the documentation for the SAT HDR transmitter, the Random Mode is automatically enabled/disabled as a function of whether the Random buffer is empty or not: Random buffer empty → Random mode disabled, Random buffer not empty → Random mode enabled. The other condition is that the Random channel must be set to a valid non-zero value.
4. The SAT HDR transmitter Self-Timed buffer is currently empty. As explained in section 7 DIRECT COMMUNICATIONS COMMANDS, GOES BUFFER COMMAND, the PDAS-III loads the Self-Timed transmitter buffer in packets of up to 96 bytes as the local GOES transmit buffers are filled. At two minutes prior to transmission all remaining data is loaded into the SAT HDR. In the example above, **Buf Size 0** because the PDAS GOES buffers are yet to be flushed into the transmitter. To view the contents of any one of the PDAS-III GOES buffers use the 'G' command as per section 7.

⇒ Select **3 Last Message Status** as follows:

3<CR>
3 Last Message Status F=00 R=00

G=00 Latitude 45:31:21 Longitude -75:12:39

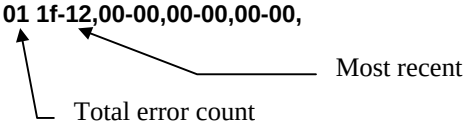
where **F** : Forward transmission power
R : Reflected transmission power

⇒ To manually insert a message into a transmission select **4 Insert String to GOES Buffer** as follows:

4<CR>
Select GOES Buffer
0 Self-timed
1 Random
0<CR>
Enter ASCII string
First test<CR>

⇒ Select **5 Error Status** to display the most recent errors logged in the SAT HDR:

Error Status 01 1f-12,00-00,00-00,00-00,



Which indicates that one error occurred with a command code of "1f" and error code of "12". "1f-12" signifies that a "Power supply fault" occurred. The error file stores the four most recent errors that occurred with the transmitter. For an explanation of the command and error codes please refer to Appendix H of this manual.

⇒ Select **6 Reset Error Counter** to clear the error file.

5.2. Main Menu: VIEW DATA

The data from any given sensor may be read without having to look at the recorded values in the log file. View Data allows the user to access sensors in real-time. By selecting item **2 VIEW DATA** of the Main Menu a sub-menu appears as follows:

---VIEW SENSOR DATA---
0 Current Time
1 Instantaneous Data
2 Captured Block Data

⇒ Selection '0' displays the current time.

⇒ Selection '1' allows the user to view real-time data from the sensors set-up in the *Sensor Log Table* as follows:

-- VIEW SENSOR DATA --
HG=0, WV=1,

Select Log Slot 0 - 15
0<CR>

The print-out begins immediately after typing <CR>. A new line appears at regular intervals and includes the date, time, sensor label and data. For example, if the "view data period" is set to 3 seconds (see 5.6) the display would be as follows:

+1997/06/04 11:30:00 HG =+1.00
+1997/06/04 11:30:03 HG =+1.02
+1997/06/04 11:30:06 HG =+1.02
+1997/06/04 11:30:09 HG =+1.05 etc…

To stop the print-out simply press <CR>. Note that these are not values that are being logged as they are displayed but rather sensor data that is transmitted to your terminal as the result of real-time polling at a given rate. Note that '0' in the string 'HG=0' refers to the *Sensor slot* to which the parameter is assigned (see section Main Menu: SENSOR LOG TABLE).
In the example above slot#1 is occupied by parameter "WV". The user could therefore select '1' to view real-time data from that sensor.

⇒ Selection '2' displays a list of captured data as configured in any given *Sensor Slot* (see 5.3.1):

-- VIEW CAPTURED DATA --
HG=0, WV=1,

Select Log Slot 0 - 15
0<CR>

2.525
2.524
2.524
2.526
2.525

5.3. Main Menu: SENSOR LOG TABLE

This selection requires PROGRAM-password clearance (see section 5 MENU TREE REFERENCE).

Selecting item **3 SENSOR LOG TABLE** from the Main Menu displays the following sub-menu:

-- SENSOR LOG TABLE --
0 Display Log Table
1 Display Equation Setup
2 Add/Edit Sensor
3 CLEAR Log Slot A=All
4 Data Processing-Enabled
M - Main Menu

This is where the logging schedule of sampled data is set-up. It is also where the conversion equations are defined as shown in section 5.3.3. The *Sensor Log Table*, which presents the setup parameters in a tabular format, lists the sensors and their corresponding logging parameters such as sampling rates and time intervals for both log entries and min/max entries.

⇒ Here is an example *Sensor Log Table* as displayed with item **0 - Display Log Table**:

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap/ Log	Logging Rate	Min/Max Rate	MM Time
0	1	1A1M0! /1	HG	00:05:00	12:33:00	- I	01:00	24:00	23:55
1	0	07	VB	00:10:00	12:30:00	- I	01:00	00:00	hh:mm
2	0	1A2M0! /1	WV	00:01:00	12:35:00	- I	01:00	00:00	00:00
3	1	1A1M0! /1	QR	00:15:00	12:36:00	- I	01:00	00:00	hh:mm
4	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
5	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
6	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
7	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
8	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
9	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
10	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
11	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
12	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
13	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
14	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm
15	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm

Each row of the table is known as a slot (numbered from 0 to 15). A sensor must be entered in a slot to be monitored by the data logger and the values entered in each column determine how the sensor is monitored. The 16 slots (rows) allow up to 16 parameters to be monitored by the data logger. The function of each column is as follows:

Slot No. : This is just an index for the 16 slots. When using the "View Data" function the slot number is requested to determine which of the sensors is to be viewed.

Log Enable: This flag determines whether the current slot is active or not.

1 - Logging is active (enabled). Currently acquiring a block (if applicable).
B - Logging is active ('block logging' mode), between blocks of data. See section 5.3.1.
0 - Logging is inactive, i.e., *Start Time* has yet to occur.

In the sensor log table above, slots #0 and #3 are enabled.

Sensor Command: The first character of this string is, in fact, a flag used to identify whether the sensor is internal (eg. analog, event counters, built-in shaft encoder) or SDI-12. Additionally, these sensors may be automatically powered on and off, in which case the *Sensor Command* is preceded with the character "S".

0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors

In the sensor log table above, this field is set to '1' for slot #0 because the slot is occupied by a SDI-12 sensor (an external SDI-12 water level sensor).

The term *Internal sensor* applies, for instance, to the built-in shaft encoder which is present when the PDAS-III is ordered with option PSE/D (refer to 5.3.2 INTERNAL (ANALOG) SENSORS). In this case a '0' appears for the first character of the *Sensor Command*. Note that the built-in shaft encoder is set to address 'A2' and that the logger always assumes it to be at that address, i.e., do not change the address of the PSE/D. Also, if your PDAS is NOT shipped with the PSE/D option, address 'A2' may be used to set-up an external sensor as "internal" provided that the command "aM0!" is supported by the sensor. To do this simply set your sensor to address "A2" and enter it in the "*Sensor Log Table"* as an "*Internal Sensor"* as "*Shaft Encoder*". Refer to 5.3.2 INTERNAL (ANALOG) SENSORS.

The PDAS also features a switched 12 VDC power port for sensor activation. When a sensor is configured to be activated by the switched power port it appears in the sensor log table with a "S" for the first character of the *Sensor Command.*

The remainder of the string is the SDI-12 command that is used to initiate a measurement as well as the addition of an indicator such as '/1' or '/8'. This indicator is used to support the ability of SDI-12 commands to return several parameters and specifies the desired parameter to be logged among those returned. The user can, for example, specify that the seventh parameter be logged by using '/7'. Note that the PDAS loggers automatically issue 'aD0!', 'aD1!', … commands until the desired value is retrieved.

Note that the PDAS allows the user to log up to 9 separate parameters with a single SDI-12 command for **multi-parameter sensors**. The PDAS allows the user to do so while specifying a distinct *Sensor Label, Logging Rate, Min/Max Rate* and *Conversion Equation* for each parameter. To see an example of "**multi-value**" SDI-12 mode refer to section 4.3.5.

In the sensor log table above, this field is set to 'A1M0! /1' in slot #0 because 'aM0!' is the correct command for measurement initiation of the SDI-12 sensor mounted on channel A at address 1 and we desire the first parameter of those returned, hence "/1".

Sensor Label : This is the label which will appear in the log file and is the only means of identifying a given sensor in the file. The string must be no longer than 8 characters.

Sampling Rate : The sampling rate is expressed in hours, minutes and seconds. Therefore the shaft encoder of slot 0 (example above) is sampled at every 30 seconds.

Start Time: This is the user-specified time when the sampling will begin.
In the event that a power interruption takes place, the logger calculates a new "Start Time" so that the sampling and logging remain synchronized. This new calculated "Start Time" is then displayed in this column. The log slot is automatically disabled (i.e. logging is rendered inactive) until the onset of the calculated "Start Time".
NOTE 1: Always specify a *Start Time* of "00:00" for slots that are to be triggered automatically by an alarm (see section 5.5 Main Menu: SENSOR ALARM TABLE).
NOTE 2: It is advisable that the Start Times for the various sensors be staggered by one second to ensure the integrity of the data.

Instantaneous/**B**lock **A**verage/**C**apture/**L**og**:** These flags indicate the type of logging taking place. An example of "instantaneous"-type logging is shown on the next page. Block logging, including averaged data, is covered in section 5.3.1.

Logging Rate: The rate at which samples are logged. This value is expressed in hours and minutes. Note that the PDAS has the ability of logging instantaneous or average values. When logging instantaneous values the unit simply logs the most recent sampled data from the sensor. This mode of logging is denoted by a "- I" next to the time interval in the sensor log table as shown above. When logging average values the unit calculates the mean of the data sampled from the sensor since the last logged entry. This mode of logging is indicated by "- A".

Min/Max Rate : The time interval between min/max entries is expressed in hours and minutes. The min/max values for any given time interval are updated internally every time the sensor is sampled as determined by the sampling rate. These values are then entered into the log file at a rate indicated for "Min/Max Rate".

MM Time: This is the Start Time for logging Min/Max values. See "Start Time" above. NOTE: Always specify a *MM Time* of "00:00" for slots that are to be triggered automatically by an alarm (see section 5.5 Main Menu: SENSOR ALARM TABLE) .

⇒ Sensors are added to the sensor table with menu item **2 - Add/Edit sensor**. For example, if the user wishes to enter the AMASSER PSE-SDI Shaft Encoder into log slot #0 as shown in the table above he/she would typically do as follows:

2<CR>
Select Log Slot 0-15
0<CR>
---SELECT SENSOR TYPE---
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
1<CR>
Enter SDI-12 Port & Address: A(0-9) or B(0-9) A1<CR>
Enter SDI-12 Port & Address: A(0-9) or B(0-9) **A1** <CR>
Enter SDI-12 Command: M(0-9) or R(0-9) or C(0-9) M0<CR>
Enter SDI-12 Command: M(0-9) or R(0-9) or C(0-9) **M0** <CR>
Enter Number of Data Values to be Logged 1<CR>
Enter Value Position: (1 - 9) 0
Enter Value Position: (1 - 9) 1<CR>
Sensor label: HG<CR>
Sensor label: **HG** <CR>
Sampling Interval (hh:mm:ss) 00:00:00 00:05:00<CR>
Sampling Interval (hh:mm:ss) 00:05:00 <CR>

Sample every 5 min.

Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total

Selections '1', '2' , '3'and '4' are covered in section 5.3.1 BLOCK FUNCTIONS.

0<CR>
Logging Interval (hh:mm) 00:00 01:00<CR>
Logging Interval (hh:mm) 01:00 <CR>
MinMax Log Interval (hh:mm) 00:00 24:00<CR>
MinMax Log Interval (hh:mm) 24:00 <CR>

Log once an hour.

Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial

These options are covered in section 5.3.3

xU - User Defined
xB - Block Functions
where x = (0,1or2)
0<CR> ◄

No conversion equation required because the sensor in this example provides data in engineering units.

Current Time - 12:32:00
Enter SAMPLING Start Time (hh:mm:ss) 00:00:00
12:33:00 <CR>
Enter SAMPLING Start Time (hh:mm:ss) 12:33:00 <CR>
Current Time - 12:32:00
Enter MinMax Start Time (hh:mm:ss) 00:00
23:55<CR>
Enter MinMax Start Time (hh:mm:ss) 23:55 <CR>

Log slot #0 would then appear as shown in the *Sensor Log Table* above. The **Log Enable** column will automatically become '1' at 12:33:00 (the *Start Time)* as requested.

The operation of the PDAS with respect to **Start Time** is worth noting. In order to facilitate the set-up of the PDAS and to verify that logging will take place as anticipated, the first log entry occurs within one minute of the specified **Start Time** regardless of the *Logging Rate* specified in the *Sensor Log Table.* This useful feature allows the user to view a log entry without waiting for the logging interval to expire. For example, because the user specified a **SAMPLING Start Time** of 12:33:00 in the example above, the first log entry will occur prior to 12:34 in spite of the fact that the *Logging Rate* is hourly. The result is that field installations are quickened.

Note that the use of a **Start Time** of '00:00:00' is for slots which are intended to be automatically enabled by an alarm (see 5.5). If a **Start Time** of midnight is desired enter the value '24:00:00'.

The following can be noted from the above interaction:

- **SELECT SENSOR TYPE → 1 SDI-12 Sensor**: because an SDI-12 sensor is to be added in this case to the *Sensor Log Table.*

  Alternatively, the user can opt to power the sensor on and off automatically by connecting it to the "*+12V sw*" terminal (see section 8.3) and enter "S1" when prompted (**SELECT SENSOR TYPE → S1 for SDI-12 Sensors)**. The switched port is utilized to conserve energy when using sensors with relatively large power requirements and which do not require sensing a parameter continuously. In this configuration, the sensor is powered up at a user-definable time prior to sending a measurement command (see section 5.6). Upon receiving the response the sensor is turned off. Note that this method is not applicable to sensors that must be powered continuously such as shaft encoders.

- the SDI-12 addresses are numbered from 0 to 9 on both channels "A" and "B" ,
- the user need not put "!" at the end of the SDI-12 command as this is done automatically by the logger,
- When prompted "**Enter value position (1-9)**" a "1" was entered since we desired the first of the parameters returned, that is, the "stage" (only one parameter may, in fact, be returned by the sensor).
- the sampling interval is expressed in hours, minutes and seconds whereas the logging and min/max intervals are expressed in hours and minutes,
- the user is given the option of logging instantaneous (individual) values or blocks of data (see 5.3.1 BLOCK FUNCTIONS),
- a conversion equation (sensor equation) was not defined (**Select Sensor Equation Type→none**) because the sensor in question provides data in engineering units, and
- the user indicates when the sampling begins. Note that the start time is expressed from 00:00:01 to 24:00:00 (midnight) and that all seconds within the day are valid, that is, there are no restrictions and midnight (24:00:00) is a valid start time. A new feature to PDAS loggers with firmware 2.0, and later, is that the *Start Time* is specified in hours, minutes **and seconds**. Therefore the user has complete control to within a second as to when sampling occurs.

Here again is the *SENSOR LOG TABLE* submenu:

-- SENSOR LOG TABLE --
0 Display Log Table
1 Display Equation Setup
2 Add/Edit Sensor
3 CLEAR Log Slot A=All
4 Data Processing-Enabled
M - Main Menu

⇒ **0 Display Log Table** to view the current logging setup of all sensors as described at the beginning of this section.

⇒ **1 Display Equation Setup** to view the user-defined conversion equations corresponding to the sensors that are setup for logging. These equations are presented in tabular format as follows:

Slot No.	Log Enable	Sensor Command	Label	Equation Type	Scale	Offset
0	1	1A1M0! /1	HG	0	+0	+0
1	0	07	VB	0	+0	+0
2	0	1A2M0! /1	WV	0	+0	+0
3	1	1A1M0! /1	QR	1p	+1	-5.000
4	0			0		
5	0			0		
6	0			0		
7	0			0		
8	0			0		
9	0			0		
10	0			0		
11	0			0		
12	0			0		
43	0			0		
14	0			0		
15	0			0		

Equation Type: The flags that appear in this column represent the type of conversion equations that have been defined for the parameter assigned to that slot. The PDAS rev E (and later) allow the user to apply a variety of equations including simple linear formulas, polynomials and trigonometric functions. Refer to section 5.3.3.

Offset and **Scale** : These values are defined by the user if a linear conversion equation is applied to the data as shown in section 5.3.3. These columns are set to zero if no linear conversion has been defined.

⇒ Item **3 - Clear Log Slot** clears a log slot for future use. Clears all slots if the user then enters 'A' for all.

⇒ Item **4 Data Processing** allows the halt all sampling and logging. By selecting this item the data processing is either "Enabled" or "Disabled" as displayed next to this menu item. When data processing is disabled the **Log Enable** column is cleared (i.e. all zero) and sampling and logging will not resume until this menu item is selected to enable data processing. When data processing is enabled (from a disabled state) new *Start Times* are calculated and sampling and logging resumes when these start times have been achieved.

5.3.1. BLOCK FUNCTIONS

As mentioned in the previous section, the user has the option of logging instantaneous or **blocks** of data. These blocks are defined by a *number of samples* as well as the *sampling rate*. There are three options with respect to block logging: **Block Log**, **Block Average, Block Capture** and **Block Total.**

Block Average: logs the average value of the block of data to the log file. See Example 1 below. Also, "Block Average" can provide vector averaging in applications where a sensor is measuring WIND DIRECTION (see the example p. 4-15).

Block Log: logs the block of data to the log file. In order to achieve logging rates greater than once a minute the user must use the Block Log feature. See Example 2 in this section.

Block Capture: saves the block of data to the *capture memory buffer*. This buffer only contains the most recent block. The contents of the buffer may be viewed from **VIEW DATA** (see section 5.2). See Example 3 in this section. The contents of the buffer are accessible to user-defined equations.

Block Total: adds all samples in the block of data and logs the result. "**Block Total**" is useful for sensors that require an integration over a period of time such as some solar radiation sensors. See Example4.

EXAMPLE 1: Assume a water level sensor for which the **AVERAGE DATA** is calculated using a block of 20 samples that are 2 seconds apart and is logged hourly.

⇒ 2<CR> {Add/Edit Sensor}
Select Log Slot 0-15
0<CR>
.
. {refer to section 5.3}
.
Sampling Interval (hh:mm:ss) 00:00:00 00:00:02<CR>
Sampling Interval (hh:mm:ss) 00:00:02 <CR>
Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
1<CR>
Select Log Data Function 1
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
<CR>
Enter Number of Samples 00
20<CR>
Enter Number of Samples 20
<CR>

Logging Interval (hh:mm) 01:00 <CR>
MinMax Log Interval (hh:mm) 24:00 <CR>

Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial

Sample rate set to 2 seconds.

Select "Block Average".

Specify 20 samples.

Default is for no conversion equation.

These options are covered in section 5.3.3.

xU - User Defined
xB - Block Functions
where x = (0,1or2)
<CR> ← No conversion equation desired.
Current Time – 12:32:00
Enter SAMPLING Start Time (hh:mm) 00:00:00 12:33:00<CR>
.
.
.

Log slot #0 of the *Sensor Log Table* would be thus:

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap/ Log	Logging Rate	Min/Max Rate	MM Time
0	0	1A1M0! /1	HG	00:00:02	12:33:00	- B20A	01:00	24:00	23:55
1	0	07	VB	00:10:00	12:30:00	- I	01:00	00:00	hh:mm
2	0	1A2M0! /1	WV	00:01:00	12:35:00	- I	01:00	00:00	00:00
3	1	1A1M0! /1	QR	00:15:00	12:36:00	- I	01:00	00:00	hh:mm
					. . .				

Note that the column "-B20A" indicates the type of logging taking place, that is, **B**lock **A**verage of **20** samples of data.

EXAMPLE 2: The user wishes to log blocks of data every 10 minutes. Each block is to consist of 30 samples of data, 1 second between samples.

⇒ 2<CR> {Add/Edit Sensor}
Select Log Slot 0-15
0<CR>
.
. {refer to section 5.3}
.
Sampling Interval (hh:mm:ss) 00:00:00 00:00:01<CR> ← Sample rate set to 1 seconds.
Sampling Interval (hh:mm:ss) 00:00:01 <CR>
Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
3<CR> ← Select "Block Log".
Select Log Data Function 3
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
<CR>
Enter Number of Samples 00
30<CR> ← Specify 30 samples.
Enter Number of Samples 30
<CR>
Logging Interval (hh:mm) 00:00 00:10<CR>
Logging Interval (hh:mm) 00:10
.
.
.

Log slot #0 of the *Sensor Log Table* would be thus:

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap/ Log	Logging Rate	Min/Max Rate	MM Time
0	1	1A1M0! /1	HG	00:00:01	12:33:00	- B30L	00:10	24:00	23:55

. . .

Note the 7th column from the left indicates that **B**locks of **30** samples are **L**ogged ("B30L").

EXAMPLE 3: The user wishes to **CAPTURE** blocks of data consisting of 10 samples of a water level sensor, 3 seconds apart. The user wishes to refresh the captured data once an hour.

⇒ 2<CR> {Add/Edit Sensor}
Select Log Slot 0-15
0<CR>
.
. {refer to section 5.3}
.
Sampling Interval (hh:mm:ss) 00:00:00 00:00:03<CR>
Sampling Interval (hh:mm:ss) 00:00:03 <CR>
Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
2<CR>
Select Log Data Function 2
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
<CR>
Enter Number of Samples 00
10<CR>
Enter Number of Samples 10
<CR>
Logging Interval (hh:mm) 00:00 01:00<CR>
Logging Interval (hh:mm) 01:00
.
.
.

Sample rate set to 3 seconds.

Select "Block Capture".

Specify 10 samples.

The user specifies to capture 10 new samples every hour.

Log slot #0 of the *Sensor Log Table* should be something like:

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap /Log	Logging Rate	Min/Max Rate	MM Time
→ 0	1	1A1M0! /1	HG	00:00:03	12:33:00	- B10C	01:00	24:00	23:55
1	0	07	VB	00:10:00	12:30:00	- I	01:00	00:00	hh:mm
2	0	1A2M0! /1	WV	00:01:00	12:35:00	- I	01:00	00:00	00:00
3	1	1A1M0! /1	QR	00:15:00	12:36:00	- I	01:00	00:00	hh:mm

. . .

The *View Data* facility (see section 5.2) allows the user to view the contents of captured blocks of data for any given log slot. Note the 7th column from the left indicates that **B**locks of **10** samples are **C**aptured to the

capture memory buffer ("B10C"). Note that "Logging Rate" in this context refers to "Logging to the capture memory buffer" not to the usual log file. This memory buffer is always cleared prior to reloading the new samples. The "Block Capture" feature of the PDAS is used with functions that require blocks of data, such as the calculation of standard deviation.

EXAMPLE 4: A solar radiation sensor is to be connected to the PDAS to measure total hourly flux. This is to be measured using 720 samples, 5 seconds apart, logged hourly. To obtain total flux the logger must add the 720 samples that take place over the hour and log the result, i.e., the "**Block Total"** function. Also, the raw data must be converted to the proper engineering units. This is described in section. 5.3.3 and 5.6.2

⇒ 2<CR> {Add/Edit Sensor}
Select Log Slot 0-15
0<CR>
.
. {refer to section 5.3}
.
Sampling Interval (hh:mm:ss) 00:00:00 00:00:05<CR>
Sampling Interval (hh:mm:ss) 00:00:05 <CR>
Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
4<CR>
Select Log Data Function 4
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
<CR>
Enter Number of Samples 00
720<CR>
Enter Number of Samples 720
<CR>
Logging Interval (hh:mm) 00:00 01:00<CR>
Logging Interval (hh:mm) 01:00
.
.
.

Sample rate set to 5 seconds.

Select "**Block Total**".

Specify 720 samples.

The user specifies to add 720samples and log the result every hour.

Log slot #0 of the *Sensor Log Table* should be something like:

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap /Log	Logging Rate	Min/Max Rate	MM Time
0	**1**	**01**	**RN**	**00:00:05**	**12:00:00**	**- B720T**	**01:00**	**00:00**	**hh:mm**
1	0	07	VB	00:10:00	12:30:00	- I	01:00	00:00	hh:mm
2	0	1A2M0! /1	WV	00:01:00	12:35:00	- I	01:00	00:00	00:00
3	1	1A1M0! /1	QR	00:15:00	12:36:00	- I	01:00	00:00	hh:mm

. . .

5.3.2. INTERNAL (ANALOG) SENSORS

"Internal sensors" in this context refers to any parameter measured by the on-board Analog Input Subsystem (AIS) that is included with every PDAS-III. These parameters are listed when the user opts to enter an "internal sensor" into the *Sensor Log Table* for logging. Here is that list:

---SELECT SENSOR---
1,2,3 or 4 Single Ended Ch#
5 Aux. (0-20)V
6 Lithium V
7 Main Pwr V
8 Internal Temp
9 Differential 1-2
10 Differential 3-4
11 Event 1 /D
12 Event 2 /D
{13 PSE Shaft Encoder}

Item **13 PSE Shaft Encoder** may or may not appear in the list of internal sensors depending on the version of software being used. When present, it is selected to set-up the built-in shaft encoder that is included with units equipped with option "/PSE" or "/PSE/D". Otherwise, as noted in the previous section, selection **13 PSE Shaft Encoder** may be used with PDAS units NOT equipped with PSE/D if the user wishes to configure an external SDI-12 sensor as "internal". To do this simply set the external SDI-12 sensor to address 'A2' and select **13 PSE Shaft Encoder** when entering the sensor into the *Sensor Log Table*. The user can henceforth configure this sensor using the *Internal Sensors* submenu as shown in 5.6 Main Menu: SYSTEM SETUP.

Adding an Internal (analog) Sensor to the *Sensor Log Table* is identical as for external sensors as shown in section 5.3 Main Menu: SENSOR LOG TABLE. Here is an example. The user wishes to monitor the primary source voltage by logging its instantaneous value six times a day and logging its min/max value once a day. From the **SENSOR LOG TABLE** submenu:

⇒ 2<CR> {Add/Edit Sensor}
Select Log Slot 0-15
1<CR>
---SELECT SENSOR TYPE---
0 Internal Sensor
1 SDI-12 Sensor
For Switched +12V Enter
S0 for Internal Sensors
S1 for SDI-12 Sensors
0<CR>
---SELECT SENSOR---
1,2,3 or 4 Single Ended Ch#
5 Aux. (0-20)V
6 Lithium V
7 Main Pwr V
8 Internal Temp
9 Differential 1-2
10 Differential 3-4
11 Event 1 /D
12 Event 2 /D
13 PSE Encoder
14 PSE Event Cnt1
15 PSE Event Cnt2

7<CR>
Sensor label: VB<CR>
Sensor label: VB <CR>
Sampling Interval (hh:mm:ss) 00:00:00 00:10:00<CR>

Sampling Interval (hh:mm:ss) 00:10:00 <CR>
Select Log Data Function 0
0 Instantaneous
1 Block Averaged /wd
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
4 Block Total
<CR>

User accepts the current selection ("Instantaneous") by pressing *Enter*.

Logging Interval (hh:mm) 00:00 04:00<CR>
Logging Interval (hh:mm) 04:00 <CR>

MinMax Log Interval (hh:mm) 00:00 24:00<CR>
MinMax Log Interval (hh:mm) 24:00 <CR>

No logging of min/max by accepting an interval of "24:00".

Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
xB - Block Functions
where x = (0,1or2)

These options are covered in section 5.3.3

<CR>
Current Time - 12:25
Enter SAMPLING Start Time (hh:mm:ss) 00:00:00 12:30:00<CR>
Enter SAMPLING Start Time (hh:mm:ss) 12:30:00 <CR>

The *Sensor Log Table* would thus appear as follows:

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap/ Log	Logging Rate	Min/Max Rate	MM Time
0	0	1A1M0! /1	HG	00:00:03	12:33:00	- B10A	01:00	24:00	23:55
→ 1	0	07	VB	00:10:00	12:30:00	- I	04:00	24:00	hh:mm
2	0	1A2M0! /1	WV	00:01:00	12:35:00	- I	01:00	00:00	00:00
3	0	1A1M0! /1	QR	00:15:00	12:36:00	- I	01:00	00:00	hh:mm
. . .									

Configuring the PDAS-III to sample and log data from an external analog sensor is accomplished by selecting the desired channel from the **---SELECT SENSOR---** menu shown above. Therefore, the user types '1', '2', '3' or '4' for single-ended applications and '9' or '10' for differential measurements as per the menu selections. ALWAYS ENSURE THAT THE INPUT RANGE OF THE SELECTED CHANNEL IS ADEQUATE FOR THE SENSOR AND APPLICATION. Therefore, either select a channel with the appropriate default input range, or configure the range of the input to your needs as described in section 5.6.2 ANALOG SENSOR SETUP. To determine the default input range use the A/D CONFIGURATION COMMAND: described on p.7-2. In either case, ALWAYS ENSURE THE INPUT RANGE IS ADEQUATE **PRIOR** TO CONNECTING THE SENSOR to it.

As described in section 5.6.2 ANALOG SENSOR SETUP, the input channels for the PDAS-III are configurable to the following ranges: +/-100mV, 0-1V, 0-2.5V and 0-5.

5.3.3. **CONVERSION EQUATIONS**

This section describes the ability of the PDAS to apply equations to the incoming data. The reasons for doing this are as follows:

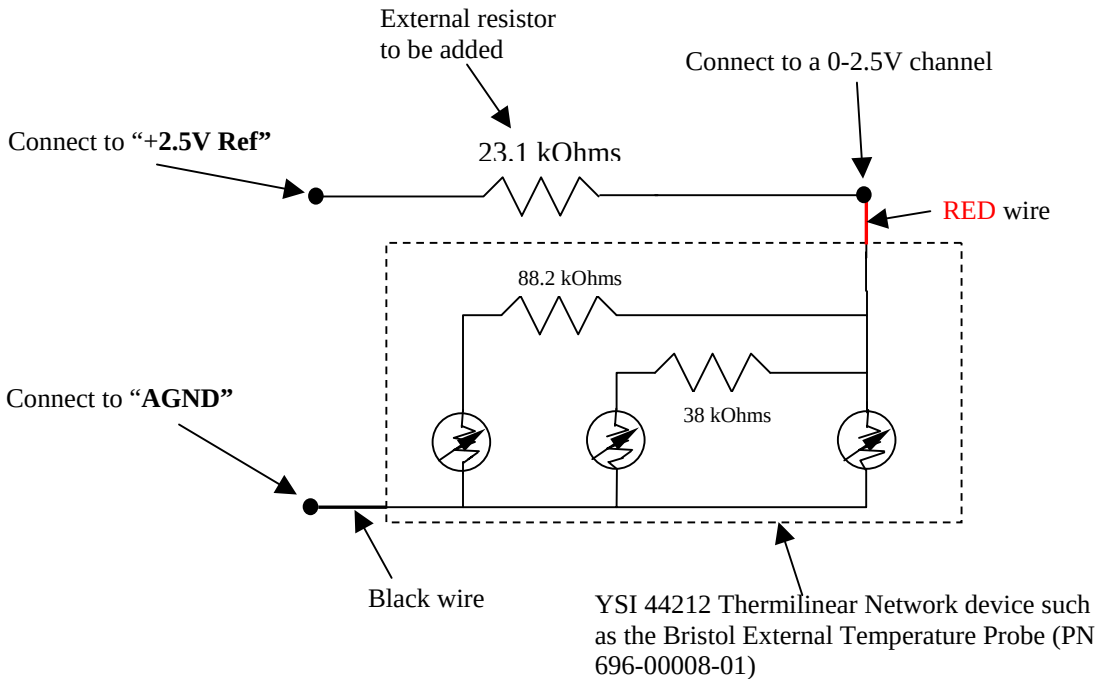
a) Convert the raw data from a sensor to the desired engineering units. This is most often applicable to analog sensors.

b) Calculate the value of an equation which uses the incoming sensor data as variables. For example, the user may wish to compute the discharge of water based on the variables "HG" and "WV".

Here are some examples:

EXAMPLE 1:

A raw-data temperature sensor is to be connected to the PDAS-III. Refer to the documentation of the sensor to determine its output range and select the appropriate channel of the AIS for measurement (see A/D CONFIGURATION COMMAND:, p.7-2). Typically these sensors can be operated in several modes ("Voltage mode", "Resistance mode", …) which requires appropriate connection. Here then is an example of such a sensor (YSI 44212 thermilinear network):



You must enter a ***Conversion Equation*** in order to convert the raw data from the sensor to units of temperature. Based on the documentation of this particular sensor, the proper values for OFFSET and SCALE are calculated to be as follows:

SCALE: -71.54
OFFSET: +106.06

Therefore, when the *Sensor Log Table* menu prompts the user as follows:

Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
xB - Block Functions
where x = (0,1or2)

…select '1' then enter the proper values for SCALE and OFFSET as shown above. Note that these values will appear in the appropriate columns in the *Sensor Log Table*.

EXAMPLE 2:

A raw-data pressure sensor is to be connected to the PDAS-III. The nominal output of the sensor is 0 to 5V and is being used to monitor a tank of pressurized gas. You wish to convert the readings to pressure in "PSI". The measurement range of the sensor is 0 to 3000 psi within the operational output range of 0.5 to 4.5V.

The values for "**Scale**" and "**Offset**" are simply determined by the properties of the linear sensor in question:

SCALE = SLOPE = (P_{FS} - P_0) / (max. voltage – min. voltage)
= (3000 – 0) / (4.5 – 0.5)
SCALE = 750

OFFSET = P_0 – (SCALE X min. voltage)
= 0 – (750 X 0.5)
OFFSET = -375

These values are defined when inserting the sensor into the *Sensor Log Table*. Therefore, to convert the raw data of this sensor to units of PSI the user must the SCALE and OFFSET shown above. When prompted:

Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
xB - Block Functions
where x = (0,1or2)

…select '1' then enter the proper values for SCALE and OFFSET as shown above. Note that these values will appear in the appropriate columns in the *Sensor Log Table.*

NOTE: The number of decimal places of the converted data is controlled by the value specified for OFFSET. Therefore if you wish to display the results of the pressure to one decimal place enter –375.0 for the OFFSET. No decimal point in the logged data would require an OFFSET of –375.

EXAMPLE 3:

Assume that the parameters 'HG' (water level) and 'WV' (water velocity) are set-up for logging as shown in the example *Sensor Log Table* of section 5.3, page 5-16. The user wishes to define an equation to compute the discharge 'QR' based on the incoming data from the SDI-12 sensor data at A1M0! and A2M0!. Assume the following equation is required for this computation:

$$\text{Discharge 'QR'} = 8.71(\text{HG} - 5)^2 + 154.307(\text{HG} - 5) + 208.1(\text{WV})$$

Note that this equation is a polynomial of the form:

$$\text{Discharge 'QR'} = C_1x^2 + C_2x + C_3$$

Where x = (HG – 5) = ((HG X scale) + offset) = ((HG X 1) + (-5.000)).
C_1=+8.71, $C_{2=}$+154.31, and C_3 = 208.1(WV)

To perform this computation the user must configure a *Sensor Slot* which samples the parameter 'HG'. The substitution x=(HG-5) shall be done by specifying that a linear conversion (where scale=+1 and offset=-5.000) be performed on the data prior to computing the polynomial (selection '1P' as shown below). The coefficient C_3 shall be defined by making a reference to log slot#2. This is done as follows:

⇒ 2<CR>
Select Log Slot 0-15
3<CR>
---SELECT SENSOR TYPE---
0 Internal Sensor
1 SDI-12 Sensor
S +12V Switched SDI-12 Sensor
1<CR>
Enter SDI-12 Port & Address: A(0-9) or B(0-9) A1<CR>
Enter SDI-12 Command: M(0-9) or R(0-9) or C(0-9) M0<CR>
Sample parameter 'HG'
Enter Value Position: (1 - 9) 1<CR>
Sensor label: QR<CR>
Sampling Interval (hh:mm:ss) 00:15:00<CR>

Select Log Data Function 0
0 Instantaneous
1 Block Averaged
2 Block Capture (Max:60 samples)
3 Block Log (Max:60 samples)
<CR>
User accepts the current selection ("Instantaneous") by pressing *Enter*.
Select Sensor Equation Type 0
0 - None
1 - (value*Scale) + Offset
2 - (value+Offset) * Scale
xP - Polynomial
xU - User Defined
xB - Block Functions
where x = (0,1or2)
Select '1P' to make the substitution x=HG-5
1P<CR>
Enter the value for Scale:
A Scale of unity should be entered as '+1', not '+1.0' if the max. calculate-speed is to be accomplished.
+1<CR>
Enter the value for Offset:
-5.000<CR>
The number of dec. places of the Offset is best entered as equal or greater than that of the incoming data. See note below.
Enter the number of Coefficients
3<CR>

+/-x.xxx "constant" or (+/-xx.xx#lsF*) "equation"
Enter Coefficient 1
+8.71<CR>

C_1 is the constant '+8.71'

+/-x.xxx "constant" or (+/-xx.xx#lsF*) "equation"
Enter Coefficient 2
+154.31<CR>

C_2 is the constant '+154.31'

+/-x.xxx "constant" or (+/-xx.xx#lsF*) "equation"
Enter Coefficient 3
(+208.1#2F*)<CR>

C_3 = 208.1(log slot#2)

Enter the number of Decimal Places:
1<CR>
Current Time 12:32:00
Enter SAMPLING Start Time (hh:mm:ss) 00:00:00 12:36:00<CR>

The *Sensor Log Table* is thus:

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap/ Log	Logging Rate	Min/Max Rate	MM Time
0	1	1A1M0! /1	HG	00:05:00	12:33:00	- I	01:00	24:00	23:55
1	0	07	VB	00:10:00	12:30:00	- I	01:00	00:00	hh:mm
2	0	1A2M0! /1	WV	00:01:00	12:35:00	- I	01:00	00:00	00:00
→ 3	1	1A1M0! /1	QR	00:15:00	12:36:00	- I	01:00	00:00	hh:mm
					...				

The *Equation Setup* table is thus:

Slot No.	Log Enable	Sensor Command	Label	Equation Type	Scale	Offset
0	1	1A1M0! /1	HG	0	+0	+0
1	0	07	VB	0	+0	+0
2	0	1A2M0! /1	WV	0	+0	+0
→ 3	1	1A1M0! /1	QR	1p	+1	-5.000
			. . .			

Note the following:

- **The coefficients are entered from the highest order term ('x^2' above) to the lowest.**
- **A "Scale" of one is best input as '+1', not '+1.0'. This is because the PDAS detects a scale of unity if it is input as '+1' to which the logger forfeits the multiplication. The result is shorter execution times.**
- The "Offset" is best entered with the number of decimal places equal to or greater than that of the data to which it is being added (or subtracted). In this case the value of 'HG' is assumed to be represented to 3 decimal places. This practice eliminates the need for the decimal-adjusting routines to be invoked and ensures no loss in precision as a result of the operation.
- **ALWAYS** enter numbers with the appropriate algebraic sign preceding it (a '+' or '-').
- **C_3 was entered as (+208.1#2F*). First note that the parentheses must be present. Also note that the format being used here is that of Reverse Polish Notation, that is, OPERAND1 followed by OPERAND2 followed by OPERATOR. Where OPERAND1 = +208.1, OPERAND2 = #2 (meaning the current data stored in log slot #2) and the OPERATOR is 'F*', that is, multiply. The operators available to the PDAS are as follows:**

Operator	Description
F+	Addition
F-	Subtraction
F*	Multiplication
F/	Division

5.4. Main Menu: LOG FILE RETRIEVAL

Item **4 - LOG FILE RETRIEVAL** of the Main Menu is used to retrieve records from the log file. The user is prompted with the following options:

---- Log File Functions ----
0 - Status
1 - Retrieve - No. of records
2 - Retrieve - from date
-f append to invoke filter
M - Main menu
3 - Log File Capacity

The log file is downloaded with either item '1' or '2'. Item **1 - Retrieve - No. of records** prompts the user for the number of records that he/she wishes to retrieve, i.e. display, whereas item **2 - Retrieve - from date** prompts the user for a date from which all records will be retrieved, up to and including that day. In order to determine the total number of log entries made as well as the amount of free memory use the "status" option. It is reasonable, therefore, to verify the status of the log file with item '0' before retrieving with either item '1' or '2'.

The user can invoke the download filter by appending '-f' to either selection '1' or '2', that is, '1-f' or '2-f'. The log file filter is defined from within the **6 System Setup → 0 Log File Functions.**

Note that if the user wishes to delete the Log file (note that this is not normally required since the PDAS uses a circular buffer by default) he/she uses the *SYSTEM SETUP* submenu (see 5.6).

⇒ Selection of **0 - Status** would be as follows:

0<CR>
Storage Capacity = 32768
Records Used = +31383
Current reading = 15000
Oldest reading = 16385
Error Flag = 0

This indicates that logging is currently taking place in sector 4 of the flash memory (explained below), that no error has occurred and that the memory has "rolled-over" at least once.

In its default configuration, the PDAS uses a "circular" buffer with 8 sectors for logging data so that when the flash is full, logging takes place over old records. The 8 sectors of the flash memory are of equal size, 4096 records, and are as follows:

Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6	Sector 7	Sector 8
1 to 4096	4097 to 8192	8193 to 12288	12289 to 16384	16385 to 20480	20481 to 24576	24577 to 28672	28673 to 32768

The non-volatile flash always contains the most recent records – a maximum of 32768. The **Oldest reading** is in fact the LOCATION of the oldest reading within the Log file which, in the example above, is the first record of sector 5. In fact, it is always the first record of a sector (with the exception of a Log file which has yet to roll-over for the first time) given that the PDAS clears all 4096 records present in a sector prior to logging the first record therein.

The **Current reading** is in fact the LOCATION where the last log entry took place, which in the previous example was 15000, that is somewhere in sector 4. Therefore, the values of both **Oldest reading** and **Current reading** determine where logging is taking place within the Flash memory.

Note that the log records are written to Flash memory. The latter is configurable as a circular buffer or not using selection **System Setup→Log File Functions→4 Flash Data Overwrite**.

The total number of records in the flash at any given time (if the buffer has rolled over at least once) is therefore equal to:

(7 X 4096) < (Total number of records) < 32768

Also,

Records Used = 32768 - (16385 - 15000) = 31383

as in the previous example.

If the buffer has yet to roll-over for the first time selection **0 - Status** would be as follows:

0<CR>
Storage Capacity = 32768
Records Used = +15000
Current reading = 15000
Oldest reading = 0
Error Flag = 0

⇒ Selection **1 - Retrieve - No. of records** is as follows:

1<CR>
-- UPLOAD -- Number of Records? xxxx
12<CR>

AMASS Data Technologies Inc. PDAS
Firmware (c)William P.Thomas 1996,97,98
DATE: 2001/08/11
TIME: 14:52:32
UNIT ID NO: T359478
SITE DESCRIPTION: BILL'S HOBBIT HOLE

,2001/08/11,
VB , +0.000/12:30:00
HG , +0.000/12:33:00
WV , +0.000/12:35:00
QR , +0.000/12:36:00
VB , +0.000/13:30:00
HG , +0.000/13:33:00
WV , +0.000/13:35:00
QR , +0.000/13:36:00
VB , +0.000/14:30:00
HG , +0.000/14:33:00
WV , +0.000/14:35:00
QR , +0.000/14:36:00

Note that this is the Environment Canada "Sequential" format. In fact, the PDAS logger supports three data formats which are user-selectable from **System Setup → Log File Functions → Log File Format** (refer to "Log File Functions" of 5.6 Main Menu: SYSTEM SETUP). The data formats are Tabular, Environment Canada Tabular (comma delimited) and Environment Canada Sequential. The data formats are shown in *APPENDIX E: PDAS DATA FORMATS*. Also refer to sections **LOG RETRIEVAL-BY-NUMBER COMMAND:** and **LOG RETRIEVAL-BY-DATE COMMAND:**

—.

Note that the log entries shown above correspond to the example *Sensor Log Table* displayed in section 5.3 (data of '+0.000' was used for simplicity):

- The SDI-12 parameter "HG" was logged at 1-hour intervals as requested: 12:33:00, 13:33:00, 14:33:00, etc…

- The SDI-12 parameter "WV" was logged at 1-hour intervals as requested: 12:35:00, 13:35:00, 14:35:00, etc…
- The parameter "VB" was logged at 1-hour intervals as requested: 12:30:00, 13:30:00, 14:30:00, etc…
- No "min/max" entries appeared in this download because the *Min/Max Start Time* was defined as 23:55 in this example whereas the current time (as per the header information) is 14:52:32.

SAME EXAMPLE BUT WITH THE "LOG FILE-FILTER" INVOKED:

1-f<CR>
-- UPLOAD -- Number of Records? xxxx
12<CR>

User specified '1-f' to invoke the filter.

AMASS Data Technologies Inc. PDAS
Firmware (c)William P.Thomas 1996,97,98
DATE: 2001/08/11
TIME: 14:52:32
UNIT ID NO: T359478
SITE DESCRIPTION: BILL'S HOBBIT HOLE

,2001/08/11,
HG , +0.000/12:33:03
HG , +0.000/13:33:03
HG , +0.000/14:33:03

Only 'HG' is retrieved. It is assumed here that the filter was defined for parameter 'HG'. Define the log file filter from **6 system setup → 0 Log File Functions**

⇒ Selection **2 - Retrieve - from date** allows the user to retrieve records based on the date of entry.

2<CR>
- Retrieve Archive back to (YYYY/MM/DD) -
2001/08/15<CR>

All records dating from midnight of 2001/08/15 to the latest entry would then be archived.

⇒ Item **3 - Log File Capacity** is very useful for sensor setup and log file management. It determines the storage capacity, in days, based on the sensor setup as it appears in the *SENSOR LOG TABLE*. It also indicates the percentage of storage space remaining. This would be a typical display with item '5':

5<CR>
--- LOG FILE CAPACITY ---
Storage Capacity = 32768 records
Storage Capacity = 11.66 days
Storage Remaining = +25.59 %

This would indicate that the current sensor setup would allow 11.66 days of data acquisition before the memory would be full assuming the log file was empty. Since there is currently 25.59% of the storage remaining the memory should endure for 2.98 days.

Note that although the log file capacity results are determined based on the current sensor setup, they are irrespective of whether the slots are active or not. The actual endurance, therefore, will be equal or greater than that displayed.

Given that the logging patterns are impossible to predict for models with alarm functions, the results achieved from the "Log File Capacity" function may in fact be very different from the actual endurance in such configurations. Even in this case, however, the results are useful for determining the absolute minimum endurance that might transpire.

5.5. Main Menu: SENSOR ALARM TABLE

This selection requires PROGRAM-password clearance (see section 5 MENU TREE REFERENCE).

Item **5 SENSOR ALARM TABLE** of the Main Menu displays the *Sensor Alarm Table*. For example:

Slot No.	Log Enable	Sensor Command	Sensor Label	UPPER Trip Value	Actions	LOWER Trip Value	Actions
0	**1**	**1A1M0! /1**	**HG**	**>+23.40**	**do/E1**	**<+23.39**	**do/D1**
1	**0**	**1A2M0! /1**	**WV**		- No Alarm Functions		
2	**0**				- No Alarm Functions		
				.			
				.			
				.			
15	**0**				- No Alarm Functions		

---SENSOR ALARM TABLE ---
1 ADD/EDIT Alarm Function
2 CLEAR Log Slot Alarms
M Main Menu

Note that the first four columns are identical as that in the *Sensor Log Table*. In fact, the *Sensor Alarm Table* is simply an extension of the *Sensor Log Table*. The former displays the alarm functions, if any, that are configured for all sensors as defined in the rightmost four columns.

The columns entitled **UPPER** and **LOWER Trip Value** are used to define the values at which the alarms are to be activated (see Figure 1 below) whereas those entitled **Actions** are used to define what is to take place when either trip value is surpassed.

⇒ The user configures alarms with item **1 ADD/EDIT Alarm Function**. To add an alarm to slot#0 as shown in the *Sensor Alarm Table* above proceed as follows:

1<CR>
---SENSOR SLOT ALLOCATION---
HG=0,WV=1,

Select Log Slot 0-15
0<CR>
Enter UPPER Trip > value +0
+23.40<CR>
Enter UPPER Trip > value +23.40 <CR>

Enter Upper Trip Actions (4 max.) No Actions
0 No Action/Proceed
D Disable Log Slot #
E Enable Log Slot #
C Activate Control Response
G Enable Random Goes Buffer
E<CR>
---SENSOR SLOT ALLOCATION---
HG=0,WV=1,

Select Log Slot 0-15
1<CR>
Enter Upper Trip Actions (4 max.) E1/
0 No Action/Proceed
D Disable Log Slot #
E Enable Log Slot #
C Activate Control Response
G Enable Random Goes Buffer
0<CR>
Enter LOWER Trip < value +0
+23.39<CR>
Enter Lower Trip Actions (4 max.) No Actions
0 No Action/Proceed
D Disable Log Slot #
E Enable Log Slot #
C Activate Control Response
G Enable Random Goes Buffer
D<CR>
Select Log Slot 0-15
1<CR>
Enter Lower Trip Actions (4 max.) D1/
0 No Action/Proceed
D Disable Log Slot #
E Enable Log Slot #
C Activate Control Response
G Enable Random Goes Buffer
0<CR>

Sensor slot#0 would then appear as shown in the *Sensor Alarm Table* above. In this example the user enabled slot#1 when the stage (HG) surpassed a specified value in order to begin monitoring the water velocity (WV). This, in fact, is one of the simplest alarm configurations possible. Note that the user also specified that slot#1 be disabled when the stage level dropped below a certain value (23.39). This is important if you do not wish the triggered slot to remain active when the stage drops some time later to lower levels.

The terms *UPPER* and *LOWER Trip Value* require further explanation. These two values are, in fact, the same alarm point but are implemented to account for hysteresis as depicted in Figure 2, where the exact trigger points are shown for the alarm configured in the *Sensor Alarm Table* above. Given that the alarm is setup to be activated by the stage (HG) of slot#0, the following can be noted with respect to Figure 1:

→ Slot#1 will be enabled ONLY IF the stage increases beyond the values of both *LOWER* AND *UPPER Trip Value*

→ Slot#1 will be disabled ONLY IF the stage decreases below the values of both *UPPER* AND *LOWER Trip Value*

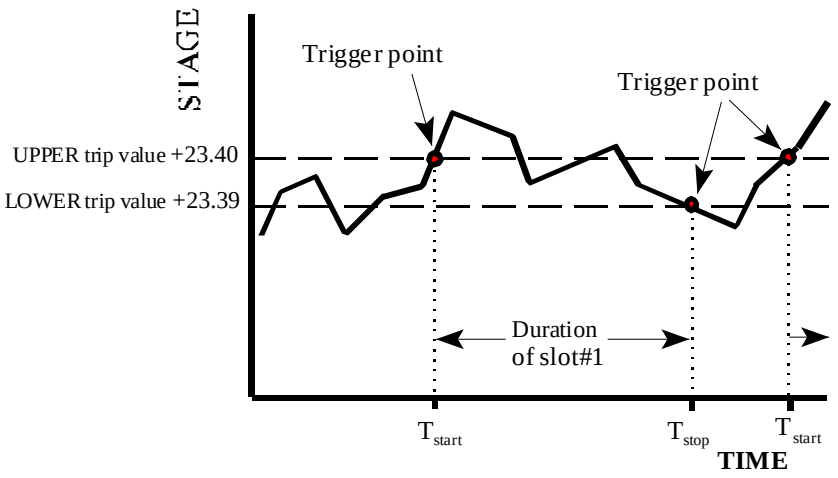


Figure 2 Implementation of *UPPER* and *LOWER trip values*.

The alarm functionality of the PDAS loggers is in fact quite powerful. When configuring even the simplest of alarms, however, it is important to ask the following questions:

- Under what conditions do I desire to begin monitoring this parameter?
- Once triggered, when do I want to stop monitoring this parameter?
- Do I want to maintain the slot that serves as a trigger?
- If not, under what conditions, if any, do I desire to reinitiate the slot that served as a trigger?

For example, if the water level is being monitored as in slot#0 above, it may be desirable to increase the logging rate when the stage attains +23.40. In this case, it is necessary to enable a new slot which will include the same *Sensor Command* and *Sensor Label* (see section 5.3 Main Menu: SENSOR LOG TABLE) and simultaneously disable the current slot (slot#0). The *Sensor Alarm Table* would be as follows:

Slot No.	Log Enable	Sensor Command	Label	UPPER Trip Value	Actions	LOWER Trip Value	Actions
0	**0**	**1A1M0! /1**	**HG**	**>+23.40**	**do/E1/E2/D0**	**<+23.39**	**do/No actions**
1	**0**	**1A2M0! /1**	**WV**		- No Alarm Functions		
2	**0**	**1A1M0! /1**	**HG**	**>+23.40**	**do/No actions**	**<+23.39**	**do/E0/D2/D1**
3	**0**				- No Alarm Functions		
				.			
				.			
				.			

As shown in the *Sensor Alarm Table* above, the following actions would take place:

- Slots#1 and #2 would be enabled when the stage attains the value of +23.40
- Slot#0 would be disabled simultaneously as slot#1 and #2 are enabled
- When the stage drops below +23.39 slot#0 becomes enabled as slot#2 and #1 are disabled

In order for the new logging rate to be carried out when slot#2 is enabled the user must specify sampling and logging rates within the **SENSOR LOG TABLE** as explained in section 5.3 Main Menu: SENSOR LOG TABLE. For example, the *Sensor Log Table* could look like this:

Slot No.	Log Enable	Sensor Command	Label	Sampling Rate	Start Time	I/B Av/Cap/ Log	Logging Rate	Min/Max Rate	MM Time
0	0	1A1M0! /1	HG	00:01:00	12:33:00	- I	00:15	02:00	23:59
1	0	1A2M0! /1	WV	00:01:00	12:35:00	- I	00:15	00:00	hh:mm
2	0	1A1M0! /1	HG	00:01:00	00:00:00	- I	00:05	01:00	00:00
					.				
					.				
					.				
15	0			00:00:00	hh:mm:ss	- I	00:00	00:00	hh:mm

NOTE: The *Start Time* for a slot that is to be triggered by an alarm must be specified as "00:00:00" (as shown above for slot#2).

5.6. Main Menu: SYSTEM SETUP

This selection requires PROGRAM-password clearance (see section 5 MENU TREE REFERENCE).

Item **6 SYSTEM SETUP** of the Main Menu displays the following setup options:

---SYSTEM SETUP FUNCTIONS---
0 Log File Functions
1 Sensor Setup
2 Logger Setup
3 Transparent SDI Mode
4 Communications
M Main Menu

⇒ Selection of **0 Log File Functions** yields the following menu:

---LOG FILE FUNCTIONS---
0 Erase Log File
1 Log File Header
2 Log File Format - Tabular EnvCdn
3 Column Delimiter
4 Log File Filter
5 Date Format - mm/dd/yyyy
6 Flash Overwrite - Disabled
M - Main Menu

0 Erase Log File deletes the entire contents of the log file. The user is prompted for confirmation before doing so.

1 Log File Header is used to edit the header information that appears when data is downloaded from the log file. This header information includes the unit identification number as well as a site description. For example,
1<CR>
UNIT ID NO:
T347857511023<CR>
UNIT ID NO: T347857511023
<CR>
SITE DESCRIPTION:
Blackburn Ck at Duclos Rd<CR>
SITE DESCRIPTION: Blackburn Ck at Duclos Rd
<CR>

2 Log File Format is used to select the desired data format when downloading from the log file as shown in *APPENDIX E*. Note that the PDAS-III (rev E) supports both Environment Canada's Tabular (comma delimited) as well as "Sequential" data formats. It also provides a user-configurable Excel-based tabular format with user-selectable column delimiters. To change the download format select **2 Log File Format.** By selecting **2 Log File Format** the data format toggles through these three options: **Tabular EnvCan**, **Excel/Lotus** and **Sequential**.

Please refer to *APPENDIX E* for examples of the available data formats as well as the examples found in sections **LOG RETRIEVAL-BY-NUMBER COMMAND:** (p.**7-4**) and **LOG RETRIEVAL-BY-DATE COMMAND:** ___ (p. **7-5**).

3 Column Delimiter is used in conjunction with the Excel/Lotus format (see **2 Log File Format** above) in that it allows the user to define the delimiter between columns. This feature accommodates various

preferences in spreadsheet programs. Note that the delimiter character is defined as its hexadecimal value in the ASCII table. Therefore, the TAB character is entered as '09' and the comma (,) character as '2C'.

4 Log File Filter is a convenient and flexible facility that allows the user to restrict the output during downloads. The data output is selectable by parameter as well as by occurrence. Therefore, the user can select to only download data from parameter 'HG', for example, and of that data only samples that occurred in the first minute of every hour. This would be done as follows:

4<CR>
--SELECT FILTER LABEL (None=N)-- N
HG=0,VB=1,WV=2,QR=3,

Select Log Slot 0-15
0<CR>
Enter Filter Interval (hh:mm:ss) HH:00:SS

Note that the user also has the option of NOT restricting the output to a single parameter by selecting 'N' (for 'None) as shown above. Therefore the output can be restricted based on occurrence only. **NOTE: THE USER HAS THE OPTION OF INVOKING OR NOT INVOKING THE FILTER AT THE TIME OF DOWNLOAD. SEE 5.4** Main Menu: LOG FILE RETRIEVAL**.**

5 Date Format - mm/dd/yyyy specifies the current date-format for data downloads. Two formats are available: 'yyyy/mm/dd' and 'mm/dd/yyyy'. Selecting '5' toggles between these two date-formats.

6 Flash Data Overwrite – Enable indicates that the flash memory is configured as a circular buffer for the log records, that is, once full the newest records overwrite the oldest ones a per section 5.4 Main Menu: LOG FILE RETRIEVAL. Select **6 Flash Data Overwrite** to disable this feature, that is, stop logging when the memory is full. Selecting **6 Flash Data Overwrite** toggles between these two options.

Here again is the *SYSTEM SETUP* submenu:

---SYSTEM SETUP FUNCTIONS---
0 Log File Functions
1 Sensor Setup
2 Logger Setup
3 Transparent SDI Mode
4 Communications
M Main Menu

⇒ Select **1 Sensor Setup** to configure the AIS and internal sensors as follows:

---SELECT SENSOR TYPE---
1 External A/D Channels
{2 PSE Encoder}
3 Temperature Units
4 Reset Event 1
5 Reset Event 2
M Main Menu

Selection '**1 External A/D Channels'** is for configuring the Analog Input System (AIS). This is explained in section *5.6.2 ANALOG SENSOR SETUP*. (PDAS-III only)

Selection '**2 PSE Encoder'** may or may not appear depending on the software in use. When present, it is used for configuring the built-in shaft encoder included with options "PSE" or "PSE/D". Note that these options refer to a PSE-SDI(/D) mounted into the same casing as the logger and set to address "A2" and that any external SDI-12 sensor set to address "A2" may also be configured as "internal" (refer to the paragraphs on the *Sensor Command* in 5.3 Main Menu: SENSOR LOG TABLE). Conversely, the built-in shaft encoder must not be changed to an address other than "A2" if it is to be configured as internal.

Selection '**3 Temperature Units'** is used for configuring the internal temperature input that is available to all PDAS-III units due to the on-board AIS (see 5.3.2 INTERNAL (ANALOG) SENSORS).

Selections '**4**' and '**5**' reset the event counter counts to zero. (PDAS-III only)

⇒ '**2 Logger Setup'** displays the following menu:

---LOGGER SETUP FUNCTIONS---
0 BootStrap Loader
1 View Data Period
2 Change PASSWORD
3 Sw-12V ON-Delay
M Main Menu

Selection '**0 BootStrap Loader**' displays the BOOT LOADER menu as described in section 4.2 SOFTWARE UPGRADES.

Selection '**1 View Data Period'** is to set the time period for the VIEW DATA facility. For example, if the user wishes to change the period from 5 to 10 seconds enter the following:
1<CR>
Enter View Data Period (1- 60) sec - 5
10<CR>
Enter View Data Period (1- 60) sec - 10
<CR>

Sensor data would now be sampled and displayed with the VIEW DATA facility at the rate of once every 10 seconds, real-time. Note that the period may be set within 1 to 60 seconds and that the default setting is 5 seconds. The VIEW DATA facility is covered in section 5.2.

Select **2 Change PASSWORD** for changing the "ENTRY" and "PROGRAM" passwords (see 5 MENU TREE REFERENCE on p. 5-2). **NOTE: The user has the option of disabling the "*Entry*" level protection simply by specifying that the password be equal to ' '(spacebar).** The "PROGRAM" level protection cannot be disabled. As mentioned in section 5. MENU TREE REFERENCE, the "ENTRY" level is for viewing data and the "PROGRAM" level is for configuring the logger.

Select **3 Sw-12V ON-Delay** for configuring the Switched 12V output. As mentioned in section 5.3, this output is used for automatically switching the 12Volt supply to sensors that consume relatively large amounts of power if left on continuously.

The Switched 12V output is configurable in that the time-delay between the power being switched on and the emission of the measurement command is user-definable. Longer delays are used for sensors that have long response times.

To change the Switched 12V time-delay select item **3 Sw-12V ON-Delay** as follows:

4<CR>
Enter (1-255) 50 msec/count 20
50<CR>
Enter (1-255) 50 msec/count 50
<CR>

The time delay was changed from 1 second (20X 50msec= 1second) to 2.5 seconds (50X50msec = 2.5 sec). Note that the sensor must be connected to the switched 12V output of the PDAS to make use of this feature.

For proper connection of the sensors to the PDAS refer to section 8.3. Also refer to 4.3.4 USE THE SWITCHED +12V.

Here again is the *SYSTEM SETUP* submenu:

---SYSTEM SETUP FUNCTIONS---
0 Log File Functions
1 Sensor Setup
2 Logger Setup
3 Transparent SDI Mode
4 Communications
M Main Menu

⇒ Select **3 Transparent SDI Mode** to operate the logger in transparent SDI-12 mode. In this mode the user enters SDI-12 commands that are encapsulated in the RS-232 data stream and relayed to sensors on the SDI-12 bus. Upon receiving an SDI-12 command the logger automatically performs all that is necessary for data retrieval, as prescribed by the SDI-12 protocol, which it then relays to the user. For example, if the AMASS Data PSE-SDI shaft encoder is mounted at address 1 on channel "A" the user may access it as such:

3<CR>

Enter SDI Command String: A(a(Command+parameters))!
A1M0!<CR>

10001+2.009
A1V0<CR>

10003+1+1+0
<CR>

The user may communicate in this manner with other SDI-12 sensors on the bus provided that the correct address is entered and that the sensor in question supports the command. Note that the "!" character need not be appended to the command as this will be done by the logger if it is omitted by the user.

Note that the user may communicate with sensors connected to the *Switched 12V* port by preceding the message with a 'S'. For example, assume the AMASS Data PAIM Analog Input Module is configured to address 'A0' and is powered by the switched 12V port:

3<CR>

Enter SDI Command String: A(a(Command+parameters))!

SA0I!<CR>
013 AMASS Data PAIM137
<CR>

When communicating with sensors the PDAS will display an error message in the event that a proper response was not received. Refer to APPENDIX A for a listing of these error messages. The SDI-12 transparent mode session is terminated by simply pressing <CR>.

⇒ Select **4 Communications** to configure the communications as such:

4<CR>
Select Communications Port
0 - Programmer Port
1 - Modem Port
2 - SDI-12 Ports A
3 - SDI-12 Ports B
0<CR>
Set Prog. Port Baud Rate
0 - 300 Baud
1 - 1200 Baud
2 - 2400 Baud
3 - 9600 Baud

4 - 38400 Baud
3<CR>

By selecting **0 - Programmer Port** the user was able to change the baud rate of the programming port from the default value of 38400 to 19200. Note that such a change in the baud rate would require the user to modify the settings of the terminal emulator accordingly. To do this using *Hyperterminal* simply click on *File*, then *Properties*, then *Configure*. Change the baud rate and click *OK*. Now click on *Disconnect* and C*onnect* so that your changes take effect.

Note that **'4 Communications'** also allows the user to change the baud rate of SDI-12 ports within the range of 300 to 19200. Note that the latter is defaulted to the current SDI-12 standard of 1200 baud (at time of printing), and that such ability is incorporated simply to accommodate revisions to the protocol and is thus not meant to be changed until such a revision occurs. Naturally, in order to be compatible with SDI-12 sensors the baud rate must be consistent with the latest standard. Please refer to the SDI-12 Support Group web site for the latest specification on the SDI-12 protocol at **http://www.sdi-12.org.**

5.6.1. Modem Configuration

PDAS loggers with "MDM" in the product name are equipped with a built-in PMDM modem.

Configuration of the baud rate of the modem port and PMDM modem is accomplished via **System Setup → Communications → Modem Port → Baud Rate** as shown below. When the user selects to change the baud rate, the PDAS attempts to reconfigure both the PMDM and the modem port of the logger. Successful configuration of the PMDM is confirmed with a response from the PMDM, which is typically as follows:

Amass Data PVMDM C182, 03

If the configuration of the PMDM was NOT successful the PDAS logger will display this message:

Modem no response

A communications breakdown between the PMDM and PDAS may be due to a mismatch of baud rates. To resume communications perform a First-Time-Initialization of the PMDM to reset the baud rate to the default of 1200.

NOTE: A FIRST-TIME-INITIALIZATION OF THE PMDM RESETS ITS BAUD RATE TO THE DEFAULT OF 1200 (for rev H systems, until further notice). Please refer to section 8.4.2 /MDM: First-Time-Initialization and the PMDM manual.

Selection of **1- Modem Port** allows the user to configure the modem port and PMDM as follows:

1<CR>
--- Modem Port ---
0 - Baud Rate
1 - AT init string
2 - AT hangup string
0<CR>
Set Modem Port Baud Rate 1
0 - 300 Baud
1 - 1200 Baud
2 - 2400 Baud
3 - 9600 Baud
4 – Cellular
5 – Prog. Port mode
2<CR>

Amass Data PVMDM C182, 02

The current baud rate of the *GOES/modem* port is shown here: 1200 baud

The response from the PMDM modem is confirmation that the configuration was accepted. Note that '02' here corresponds to 2400 baud, the desired baud rate.

Set Modem Port Baud Rate 2
0 - 300 Baud
1 - 1200 Baud
2 - 2400 Baud
3 - 9600 Baud
4 – Cellular
5 – Prog. Port mode
<CR>

Thus the modem port and PMDM were successfully configured to a baud rate of 2400. Note that the default value is 1200 baud.

'**4 – Cellular**' configures the modem to be compatible with a cellular transceiver with MNP10 error checking.

'**5 - Prog. Port Mode**' configures the modem for connection to the *Programming Port.* This allows the PDAS to have a GOES transmitter and a modem connected to it simultaneously. To achieve this configuration follow the instructions in section 8.2.4. Note that to make use of this feature the modem requires a custom cable to connect the modem to the *Programming Port.* Note that the *Programming Port* baud rate must then be set to match that of the modem, the maximum being 9600.

The **1 - AT init string** and **2 - AT hangup string** are used to customize the initialization and hang-up strings of the modem.

5.6.2. ANALOG SENSOR SETUP

The on-board Analog Input Subsystem (AIS) of the PDAS-III allows it to monitor and log external analog inputs as well as maintenance parameters. This section describes how the AIS is configurable to those inputs. As with all other configuration for the PDAS-III, the AIS set-up is stored in the EEPROM as well as the NVRAM and is thus non-volatile. For a description on how to set-up these values for logging refer to 5.3.2 INTERNAL (ANALOG) SENSORS.

Channels #5, #6, #7 and #8 are dedicated and pre-configured to the following maintenance parameters:

- Channel#5 is 0-20V for the solar panel or the 9V internal battery on models with option /PSE/D
- Lithium battery voltage on channel #6 (0-5V)
- Main voltage supply on channel #7 (0-20V)
- Internal temperature on channel #8 (0-2.5V)

The remaining channels, that is, #1 to #4, are for external inputs and are configurable to the operator's needs. The input ranges of these channels are user-configurable on the PDAS-III (rev E and F) as follows: +/-100mV, 0-1V, 0-2.5V and 0-5V. Otherwise the user may select the appropriate channel based on its default input range. Please refer to Table 3 on page 7-2 to determine the default input ranges of your logger. With suitable instruction from AMASS Data Technologies Inc, the user can further benefit from the high degree of programmability of the AIS such as performing custom "offset" and "gain" calibrations, setting the scan rates, etc…

For differential measurements the channels are used in pairs: either channels #1 and #2 OR channels #3 and #4. ONCE THE CHANNEL IS CONFIGURED FOR DIFFERENTIAL AND TO THE DESIRED RANGE, connect the sensor '+V' to #1 (or #3) and the '-V' connection to #2 (or #4). Channel #1 will henceforth refer to the difference between the potential at #1 and #2, that is,

$$V_{diff} = V_1 - V_2$$

Selecting channel #1, as described in 5.3.2 INTERNAL (ANALOG) SENSORS, can then sample and log this differential measurement.

BIPOLAR MEASUREMENTS: The PDAS-III (rev E and F) have only one bipolar range: +/-100mV. This can be used for bipolar ranges greater than +/-100mV provided proper attenuation is in place. See example and Figure 4. Attenuation of bipolar signals. on page 5-49.

Each channel that is connected to an analog sensor must be configured for that sensor. This is done from the *System Setup* menu as follows:

⇒ 1<CR>
---SELECT SENSOR TYPE---
1 External A/D Channels
2 PSE Encoder
3 Temperature Units
4 Reset Event 1
5 Reset Event 2
M Main Menu
1<CR>
--SELECT A/D Channel---
1,2,3 or 4 Single Ended Ch#
5 Differential 1-2
6 Differential 3-4

--SELECT INPUT RANGE---
1 +/-100mV
2 0-1V
3 0-2.5V
4 0-5V

---SELECT OUTPUT FORMAT---
1 (0-1.0000)
2 (0-2.500)
3 (0-5.000)
4 (+/-5.000)
5 Binary Count
6 4ma Offset Correction
7 Temperature AD34
8 Wind Direction

Custom Equation Required?
0 No
1 Yes

Proper selection from these options depends on criteria such as the following:

- Range of output of the sensor.
- Single-Ended or Differential input.
- Is the data to be converted to Volts or to some other engineering unit? If converted, to
- How many decimal places?
- Is this a 4-20 mA application?
- Are you connecting the AD34 temperature sensor?
- Are you connecting a wind direction sensor?

These various options are best explained with a few examples. Further explanations are added where warranted.

EXAMPLE 1:

DO NOT CONNECT YOUR ANALOG SENSOR TO YOUR LOGGER YET. Connect your analog sensor **AFTER** you have configured the input range as shown below.
A sensor requiring differential measurements up to 5V will be connected to channels #1 and #2 with '+V' to #1 and '-V' to #2. You wish the analog data to be converted to Volts.

--SELECT A/D Channel---
1,2,3 or 4 Single Ended Ch#
5 Differential 1-2
6 Differential 3-4
5<CR>

The user selected 'Differential 1-2'

--SELECT INPUT RANGE---
1 +/-100mV
2 0-1V
3 0-2.5V
4 0-5V
4<CR>

The user selected a range of 0-5V.

---SELECT OUTPUT FORMAT---
1 (0-1.0000)
2 (0-2.500)
3 (0-5.000)
4 (+/-5.000)
5 Binary Count
6 4ma Offset Correction
7 Temperature AD34
8 wind Direction
3<CR>
Custom Equation Required?
0 No
1 Yes
0<CR>

The set-up is complete! The sensor can now be connected to channels #1 and #2 as follows: sensor '+V' to #1 and '-V' to #2. To monitor this value simply select channel #1 (NOT #2) from the list of *Internal Sensors* as described

in 5.3.2 INTERNAL (ANALOG) SENSORS. Selecting channel #2 instead of #1 would monitor the potential of '-V' with respect to ground. Exiting the menu system and using the command 'MA1' reads the current differential value between channels #1 and #2.

EXAMPLE 2: (this example also appears on page 5-28)

DO NOT CONNECT YOUR ANALOG SENSOR TO YOUR LOGGER YET. Connect your analog sensor **AFTER** you have configured the input range as shown below.
A 0 to 5V sensor is connected to channel #2 and is being used to monitor a tank of pressurized gas. You wish to convert the readings to pressure in "PSI". The measurement range of the sensor is 0 to 3000 psi within the operational output range of 0.5 to 4.5V. Assuming that you wish to display to one decimal place, proceed as follows:

--SELECT A/D Channel---
1,2,3 or 4 Single Ended Ch#
5 Differential 1-2
6 Differential 3-4
2<CR> ← The user selected channel #2.
--SELECT INPUT RANGE---
1 +/-100mV
2 0-1V
3 0-2.5V
4 0-5V
4<CR> ← The user selected a range of 0-5V.
---SELECT OUTPUT FORMAT---
1 (0-1.0000)
2 (0-2.500)
3 (0-5.000)
4 (+/-5.000)
5 Binary Count
6 4ma Offset Correction
7 Temperature AD34
8 Wind Direction
3<CR>
Custom Equation Required?
0 No
1 Yes
1<CR>

Enter Sensor Scale
+750<CR>
Enter Sensor Offset
-375.0<CR>

The set-up is complete! The AIS will convert the analog data of channel #2 to 'PSI" based on a full scale value of 3000PSI when the sensor outputs 4.5V and 0PSI for 0.5V. To monitor this value simply select channel #2 from the list of *Internal Sensors* when adding a sensor to the *Sensor Log Table*. This is described in 5.3.2 INTERNAL (ANALOG) SENSORS.

Alternatively, the "SCALE" and "OFFSET" can be defined from within the *Sensor Log Table*. An example of this is shown in section 5.3.2 INTERNAL (ANALOG) SENSORS. That method is, in fact, completely equivalent except that the input range of the channels can only be configured from within *System Setup* as shown in this section.

Note that the user can obtain real-time readings by exiting the menu system and using the command 'MA2' to read the current value of channel #2, as described in 7 DIRECT COMMUNICATIONS COMMANDS.

Note that the number of decimal places for the converted data is specified by the value entered for the offset. The number of decimal places of the converted data will be equal to that of the value specified for the 'offset". Therefore, in the example above the pressure will be converted to one decimal place (offset=-375.0).

The values "**Scale**" and "**Offset**" are simply determined by the properties of the sensor in question:

SCALE = Slope = $\{(P_{FS} - P_0)\}$ / (max. voltage – min. voltage)
= (3000 – 0) / (4.5 – 0.5)
SCALE = 750

OFFSET = P_0 – (SCALE X min. voltage)
= 0 – (750 X 0.5)
OFFSET = -375.0

EXAMPLE 3:

DO NOT CONNECT YOUR ANALOG SENSOR TO YOUR LOGGER YET. Connect your analog sensor **AFTER** you have configured the input range as shown below.
A 4-20 mA sensor is connected to channel#3 (terminal AIN 3).

SELECT A/D Channel---
1,2,3 or 4 Single Ended Ch#
5 Differential 1-2
6 Differential 3-4
3<CR>

The user selected channel #3

--SELECT INPUT RANGE---
1 +/-100mV
2 0-1V
3 0-2.5V
4 0-5V
1<CR>

The user selected a range of 0-1V (preferred).

---SELECT OUTPUT FORMAT---
1 (0-1.0000)
2 (0-2.500)
3 (0-5.000)
4 (+/-5.000)
5 Binary Count
6 4ma Offset Correction
7 Temperature AD34
8 Wind Direction
6<CR>

The user selected '6 4mA Offset Correction'.

Custom Equation Required?
0 No
1 Yes
0<CR>

The set-up is complete! The 4mA bias has been removed. The analog data of channel #3 will henceforth be converted such that the output range of the sensor is from 0.2 (zero counts) to 1.0V (full scale). To monitor this sensor select channel #3 from the list of *Internal Sensors* as described in 5.3.2 INTERNAL (ANALOG) SENSORS.

NOTE: When connecting a 4-20 mA sensor to the PDAS-III be sure to install the proper precision termination resistor in socket "R1", "R2", "R3" or "R4" (see section 8.3 Connectors, Cables & Terminal Strips). The value of the resistor is a function of the range of the input being used as follows:

Case 1: 0-1V use 50**Ω**
Case 2: 0-2.5V use 125 **Ω**
Case 3: 0-5V use 250 **Ω**

The input range of any desired channel is configured as shown above. To determine the default input ranges of channels #1 to #4 use the "A/D CONFIGURATION COMMAND:" , see page7-2.

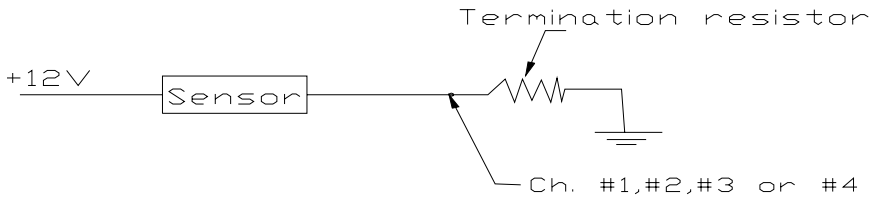


Figure 3. Proper termination resistor for 4-20 mA applications.

EXAMPLE 4:

DO NOT CONNECT YOUR ANALOG SENSOR TO YOUR LOGGER YET. Connect your analog sensor **AFTER** you have configured the input range as shown below.

A sensor requiring bipolar measurements is to be connected to channel #1. The PDAS-III (rev E later) only has one bipolar input range: +/-100mV. In order to accommodate ranges greater than +/-100mV the user must attenuate the incoming signal with a suitable resistive divider using precision resistors (tolerance at least +/-1%). Assume that the user requires +/-5V. The user must install a resistive divider similar to that shown below in order to attenuate the incoming signal to +/-100mV:

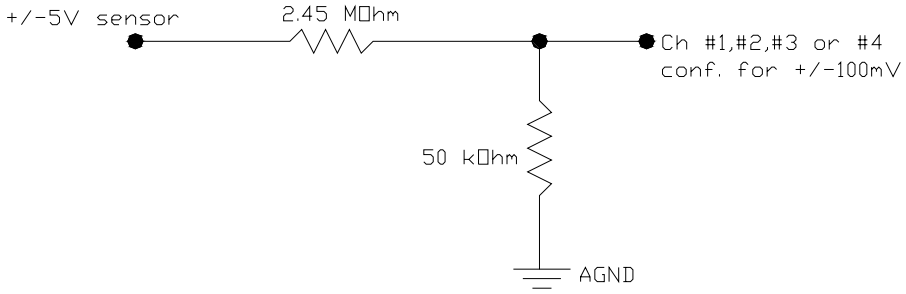


Figure 4. Attenuation of bipolar signals.

The user must then configure channel#1 to a range of +/-100mVas follows:

1<CR>
SELECT A/D Channel---
1,2,3 or 4 Single Ended Ch#
5 Differential 1-2
6 Differential 3-4
3<CR>

The user selected channel #1

--SELECT INPUT RANGE---
1 +/-100mV
2 0-1V
3 0-2.5V
4 0-5V
1<CR>

The user selected a range of +/-100mV.

---SELECT OUTPUT FORMAT---
1 (0-1.0000)
2 (0-2.500)
3 (0-5.000)
4 (+/-5.000)
5 Binary Count
6 4ma Offset Correction
7 Temperature AD34
8 Wind Direction
4<CR>
…

The sensor can now safely be connected to channel#1. In order to obtain precise measurements the user should then perform a system calibrate on this channel in order to account for inaccuracies in the resistive divider. Please contact ADT for instruction for doing this.

6. GOES DATA RETRIEVAL

In order to access the GOES data that the antenna has transmitted the user must dial-up the central DAPS facility in Wallops, Virginia using a telnet session. Once connected to the internet through your local ISP proceed as follows if using Windows XP:

- Click on *Start*, then *Run*
- Type "telnet 205.156.2.178 " and click *OK*

Now wait a moment until the DAPS prompt appears -- the telnet connection has been successful! Enter your username and password.

When the correct username and password has been accepted the user may enter the proper command for the downloading of data. Prior to doing so however, the user must begin logging the Telnet session so that the downloading of data is captured:

- Click on *Terminal* on the menu bar, then on *Start Logging…*
- Select a folder and filename for the capture file,
- click *Open*

Now assuming a platform number of 48161450, the user would type the following command at the prompt:

>DOWNLOAD MSG ID_PLATFORM 48161450<CR>
>BEGIN DOWNLOAD? (Y/N)
>Y<CR>

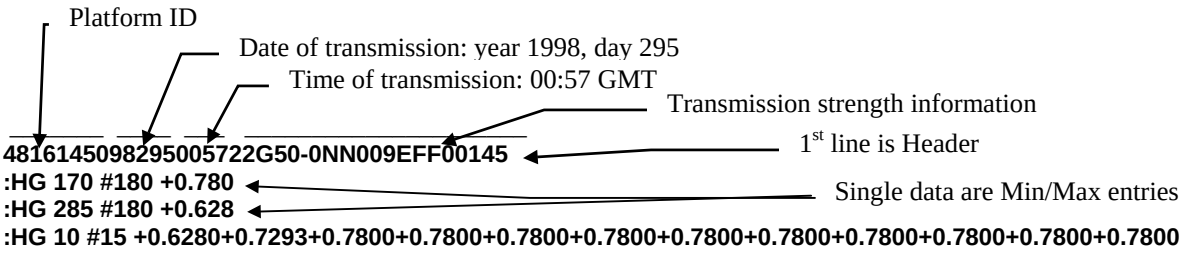
Once the data is downloaded the user stops logging the Telnet session as follows:

- Click *Terminal*, then *Stop Logging.*

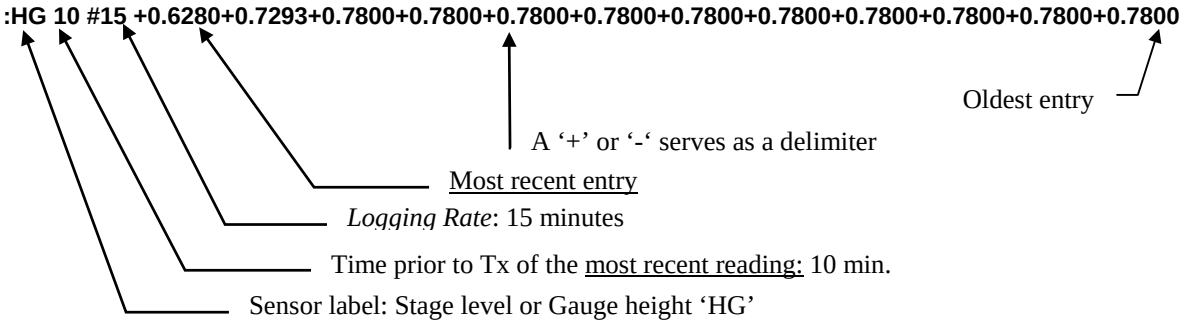
Now disconnect from the DAPS system by typing "**BYE"**.

6.1.1. GOES Data Interpretation

Here is an example of data as downloaded from the DAPS system:


Platform ID
Date of transmission: year 1998, day 295
Time of transmission: 00:57 GMT
Transmission strength information
1st line is Header
Single data are Min/Max entries
481614509829500 5722G50-0NN009EFF00145
:HG 170 #180 +0.780
:HG 285 #180 +0.628
:HG 10 #15 +0.6280+0.7293+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800

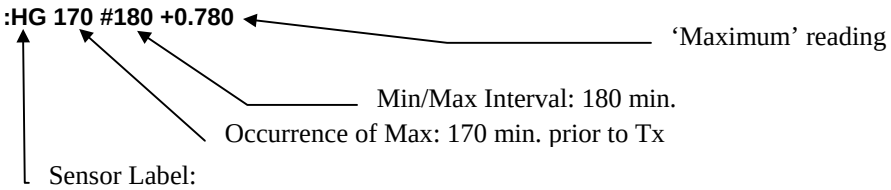
Note that the first line is a header providing information with respect to the transmission itself. The lines that follow are the data accumulated by the PDAS since the last transmission. Here is the third such line as it appears in the example above:


:HG 10 #15 +0.6280+0.7293+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800+0.7800
Oldest entry
A '+' or '-' serves as a delimiter
Most recent entry
Logging Rate: 15 minutes
Time prior to Tx of the most recent reading: 10 min.
Sensor label: Stage level or Gauge height 'HG'

The example depicts the stage level, HG, being recorded at every 15 minutes. The first entry in this line (+0.6280) was logged 10 minutes prior to transmission, that is, at 00:47 GMT. The second (+0.7293) was logged 15 minutes prior (logging interval is 15 minutes) to the first reading, that is at 00:32 GMT. The third (+0.7800) at 00:17 GMT, and so on.

As explained in section *5.3 Main Menu: SENSOR LOG TABLE*, the 'Sensor Log Table' is where the logging schedules are defined. In order to accomplish the data collection shown above, the *Logging Rate* would be set to '00:15' and the *Sensor Label* would be 'HG'. From the above we could also conclude that the PDAS-III logged average values of the stage level given that the data is recorded with four decimal places (instantaneous values appear with three).

Note that lines with single entries are Min/Max values. Here is the 'Max' reading as it appears above:



Note that the value for *Min/Max Rate* is 180 minutes in this example (Refer to section 5.3 regarding the 'Min/Max Rate'). The reading in this case was taken 170 minutes prior to transmission, that is, at 22:07 GMT. As explained in section *4.2.3*, the Min/Max values are based on the samples as defined by the *Sample Rate*, therefore the accuracy in determining the minimum or maximum of the sensed value is dependent on the frequency of the sampling, that is, the *Sample Rate*.

As the GOES-equipped PDAS-III (i.e., PDAS-III/HDR) performs its logging routines as defined in the *Sensor Log Table* (see 5.3 Main Menu: SENSOR LOG TABLE), it records data to both the internal flash, i.e. the log file, as well as to the internal PDAS-III GOES buffers. These internal buffers are 96 bytes in size, are numbered 0 to 15 and correspond to the sensor slots found in the *Sensor Log Table*. They are used so that data that is loaded into the transmitter is formatted to a fixed width. Note however, that only data that is logged according to the parameter *Logging Rate* appear in these buffers, that is, instantaneous or averaged data. Min/Max values do not use these buffers but rather are loaded immediately into the transmitter, which is why the Min/Max entries shown above have single readings only.

The user may view the contents of any of the sixteen GOES buffers if he/she wishes by exiting the menu and by typing (see section 7. DIRECT COMMUNICATIONS COMMANDS):

G#<CR>

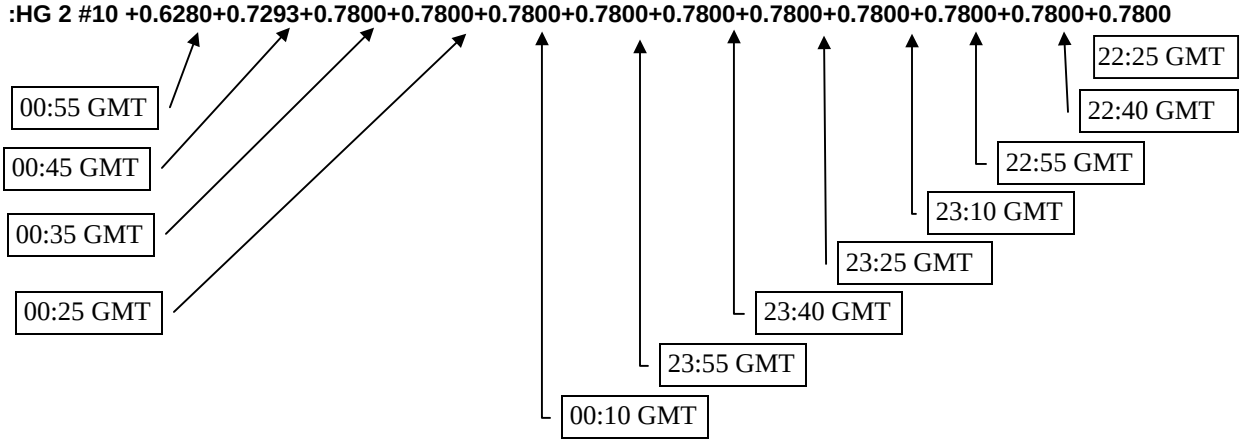
where # is the sensor slot number of the parameter whose status is desired. For instance, if the parameter labeled 'HG' occupies slot#0, then exit the menu and type 'G0<CR>' as follows:

G0<CR>
+0.6280+0.7293+0.7800+0.7800

which indicates that four readings have been loaded into the PDAS-III GOES buffer #0. When this buffer is full (96 bytes maximum) it is automatically loaded into the GOES transmitter buffer for transmission. Note as well that the current contents of the GOES buffers are automatically loaded when the user disables the transmitter.

Note that the transmitter should be disabled prior to changing the *Logging Rate* of a sensor in the *Sensor Log Table*, then re-enable the transmitter once the changes have been made. If this is not done the *Logging Rate* that appears in the header (at the beginning of any given line) may not correspond to all the entries in that line. This is because the header displays information that was current when the *Most Recent Entry* took place.

For instance, in the example above the *Logging Rate* was set to 15 minutes. If this had been changed to 10 minutes when eight readings had already been loaded into the corresponding GOES buffer, the header would display 10, not 15 minutes as such:



The readings on the left occurred at 10 minute intervals but the remaining readings were logged at 15 minute intervals.

To avoid this confusion, disable the transmitter when making changes to the *Logging Rate*, then re-enable it.

7. DIRECT COMMUNICATIONS COMMANDS

The PDAS supports a number of "*Direct Communications Commands"*. By *Direct Communications* we refer to communications that do not take place within the menu system. Simply exit the menu with **7 exit** and try these commands:

IDENTIFICATION COMMAND:

Command: I<cr>
Response: <identification string>

Example:
Command: I<CR>
Response: AMASS Data Technologies Inc PDAS/MDM C209

Therefore the unit is a PDAS data logger and is running the MDM firmware, version C209.

FORWARD SDI-12 COMMAND:

Command: F<SDI-12 command><cr>
Response: <proper SDI-12 response>

Example: You wish to determine the current SDI-12 address of a shaft encoder connected to SDI-12 channel A, then change its address to 2.

Command: FA?!<CR>
Response: 0
Command: FA0A2!<CR>
Response: 2

DIRECT MEASUREMENT COMMAND:

command: M#<CR> where #: sensor slot number
response: <date of last sample ><time of last sample><sensor label><value of last sample>

example: The parameter "HG" is allotted to sensor slot #1 and you wish to make a real-time measurement. Type this:

Command: M1<CR>
Response**: 2001/07/16 15:37:55 "HG" +9.123**

Rev. E loggers provide realtime measurements with the "M" command. Previous versions of the PDAS loggers only returned the most recent sample with the "M" command.

GOES BUFFER COMMAND:

command: G#<CR> where #: sensor slot number
response: <value><value><value><value>…

example: For instance, if the parameter labeled 'HG' occupies slot#0 and you wish to view the contents of the PDAS GOES buffer, type this:

Command: G0<CR>
Response**: +0.6280+0.7293+0.7800+0.7800**

Note that the contents of the PDAS GOES buffer is shown with the 'G' command, NOT the transmitter buffer itself. As explained in 6.1.1 GOES Data Interpretation, GOES-equipped loggers use 16 separate buffers which correspond to the 16 sensor slots. These GOES buffers acquire data at a rate defined by *Logging Rate* in the *Sensor Log Table*. Once any given one of the 16 GOES buffers is filled to its 96-byte capacity it is "flushed" into the transmitter buffer.

A/D CONFIGURATION COMMAND:

Determine the default A/D configuration of your logger (PDAS-III only), such as the input ranges of channels #1 to #4, by typing "**RC**" as such:

Command: RC<CR>
Response: <CSR> <Configuration #: 0, 1, 2 or 3>
Where

Table 3. A/D configuration options for channels #1 to #4

Configuration #	Channel Configuration
0	4 X +/-100mV, #1, #2, #3, #4
1	4 X (0-1V), #1, #2, #3, #4
2	4 X (0-2.5V), #1, #2, #3, #4
3	4 X (0-5V), #1, #2, #3, #4

Note that rev E and F have user-configurable input ranges. The '**RC**' command merely shows the configuration at the time of delivery. The input channels are labeled AIN1, AIN2, AIN3, AIN4 on the detachable terminal trip. The terminal labeled "SP/CH" is channel#5 (0-20V input) for use with a solar panel or other device requiring such an input. Note that these represent the default values which may be changed from **System Setup → Sensor Setup → External A/D Channels**

A/D MEASUREMENT COMMAND:

command: MA#<CR> where #: analog input to measure
response: <converted value>

The analog inputs are assigned as follows (PDAS-III only):

Table 4. Analog Inputs of the PDAS-III (rev E).

Input #	Analog Input
1-4	User-configurable: SEE ABOVE
5	0 - 20V Ext. Voltage for solar panel or 9V bat (PSE/D option)
6	Lithium Battery (0 - 5V input)
7	Main Voltage (0 - 20V voltage input)
8	Internal Temperature (0 - 2.5V input)

Example: Determine the Main Voltage (channel #7):

Command: MA7<CR>
Response: 12.121

EVENT COUNTER MEASUREMENT COMMAND:

command: ME#<CR> where #: event counter input to measure (1 or 2)
response: <event counter value>

Example: Assume a tipping bucket is connected to event counter #1. Read the total rainfall using a *Direct Command* as follows:

Command: ME1<CR>
Response: 2.50

The remaining commands are most useful when accessing the logger using a computer with a dial-up program which will automatically send and receive data in order to download the log file. If such is the case, the host computer need not enter the menu system but rather utilize the following *Direct Communications Commands*:

LOG STATUS COMMAND:

command: LS<CR>
response: <Log File Status>

example:

LS<CR>
Storage Capacity = 32768
Current Record = 4140
Oldest Record = 0
Error Flag = 0

LOG RETRIEVAL-BY-NUMBER COMMAND:

command: LR <"*Entry*" password> <number of records to be downloaded><CR>

- yields data in the format specified from the menu system. See 5.6.2 → Log File Functions.

Optional command: LR <"*Entry*" pwd> [-t<col. delimiter>]|[-s]|[-e] [-f] <# of rec to be downloaded><CR> meaning of flags is as follows:	
-t<col. Delimiter>	tabular (Excel/Lotus) format using specified column delimiter. Note that the delimiter character is actually typed following the 't'. For example, to use the <TAB> character as the delimiter, press the <TAB> key.
-s	Environment Canada Sequential format.
-e	Environment Canada Tabular (comma delimited) format.
-f	Invoke the download filter. The filter is defined from the menu system.

response: <Downloaded data with Header information>

Ex 1: You wish to download 40 records and the format is currently set to "Environment Canada Sequential":

LR AMASSER 40<CR>
AMASS Data Technologies Inc. PDAS/M 682
Firmware (c)William P.Thomas 1996,97,98,99,2000,2001
DATE: 2001/08/12
TIME: 10:25:36
UNIT ID NO: 01
SITE DESCRIPTION: Utopia

,2001/08/12,
VB , +12.012/06:30:05
HG , +0.973/06:33:03
. . .

Command for yielding data in "Environment Canada Tabular Format (comma delimited)". The download filter was not invoked in this instance (no '-f' flag, see examples in the next section).

Ex 2:
LR AMASSER -e 40<CR>
AMASS Data Technologies Inc. PDAS/M 682
Firmware (c)William P.Thomas 1996,97,98,99,2000,2001
DATE: 2001/08/12
TIME: 10:25:36
UNIT ID NO: 01
SITE DESCRIPTION: Utopia

DATE,TIME,HG,VB
2001/08/12,06:30:05,-99999,+12.012
2001/08/12,06:33:03,+0.973,-99999
…

LOG RETRIEVAL-BY-DATE COMMAND:

command: LD <"*Entry*" password> <DATE of oldest record to be downloaded><CR>

- **yields data in the format currently set from the menu system**

Optional command: LD <"*Entry*" pwd> [-t<col. delimiter>]|[-s]|[-e] [-f] <DATE of oldest to be downloaded><CR>

- meaning of flags is as follows:

-t<col. Delimiter>	tabular (Excel/Lotus) format using specified column delimiter. Note that the deli miter character is actually typed following the 't'. For example, to use the <TAB> character as the delimiter, press the <TAB> key.
-s	Environment Canada Sequential format.
-e	Environment Canada Tabular (comma delimited) format.
-f	Invoke the download filter. The filter is defined from the menu system.

response: <Downloaded data with Header information>

Ex 1: You wish to download all records that were logged on this day (current day is 2001/08/12):

LD AMASSER 2001/08/12<CR>

```
AMASS Data Technologies Inc.  PDAS/M 682
Firmware (c)William P.Thomas 1996,97,98,99,2000,2001
DATE: 2001/08/12
TIME: 10:25:36
UNIT ID NO: 01
SITE DESCRIPTION: Utopia

  , 2001/08/12,
VB      ,   +12.012/00:30:05
HG      ,   +0.973/00:33:03
VB      ,   +12.010/01:30:05
HG      ,   +0.973/01:33:03
.
.
.
HG      ,   +0.973/09:33:03
```

It is assumed here that the current data format is set to "Sequential" using **System Setup → Log File Functions → Log File Format**.

If the user had entered "LD AMASSER 2001/08/11<CR>", the PDAS would download all records that were logged from midnight of December 15th onward.

Note that the **Retrieval-by-Date** function can only be invoked once the clock has gone past midnight at least once.

Ex. 2:

LD AMASSER –e -f 2001/08/12

AMASS Data Technologies Inc. PDAS/M 682
Firmware (c)William P.Thomas 1996,97,98,99,2000,2001
DATE: 2001/08/12
TIME: 10:25:36
UNIT ID NO: 01
SITE DESCRIPTION: Utopia

DATE,TIME,HG
2001/08/12,00:33:03,+0.973
2001/08/12,01:33:03,+0.973
2001/08/12,02:33:03,+0.973
2001/08/12,03:33:03,+0.973
2001/08/12,04:33:03,+0.973
2001/08/12,05:33:03,+0.973
2001/08/12,06:33:03,+0.973
2001/08/12,07:33:03,+0.973
2001/08/12,08:33:03,+0.973
2001/08/12,09:33:03,+0.973

User specified "comma-delimited Environment Canada Tabular" format with '-e' flag. Invoked the download filter with '-f' flag.

Only parameter 'HG' is retrieved. It is assumed here that the filter was defined for parameter 'HG' only.

A single ',' character precedes the data for parameter 'HG' because it is allocated to *Sensor Slot* #0 (slot# + 1).

Example 3 below shows a convenient alternative to the Environment Canada Tabular (comma delimited) format. Note that the '-t' flag always incorporates labels into EVERY record whereas the '-e' flag does not (in headings only). This is an important distinction when considering that the labels that appear in the headings are only valid AT THE TIME OF DOWNLOAD. Therefore, these labels may not properly correspond with all downloaded data if the logger configuration was changed at some time since the last log file erasure. However, the labels that appear for every record ARE ALWAYS VALID. Therefore, the flag '-t,' is a logical alternative to the flag '-e'.

Ex. 3

LD AMASSER -t, 2001/08/12

AMASS Data Technologies Inc. PDAS/M 682
Firmware (c)William P.Thomas 1996,97,98,99,2000,2001
DATE: 2001/08/12
TIME: 10:25:36
UNIT ID NO: 01
SITE DESCRIPTION: Utopia

DATE,TIME,LABEL,HG,VB
2001/08/12,00:30:05,VB,,+12.012
2001/08/12,00:33:03,HG,+0.973,
2001/08/12,01:30:05,VB,,+12.010
2001/08/12,01:33:03,HG,+0.973,
2001/08/12,02:30:05,VB,,+12.010
2001/08/12,02:33:03,HG,+0.973,
2001/08/12,03:30:05,VB,,+12.009
2001/08/12,03:33:03,HG,+0.973,
2001/08/12,04:30:05,VB,,+12.009
2001/08/12,04:33:03,HG,+0.973,
2001/08/12,05:30:05,VB,,+12.009
2001/08/12,05:33:03,HG,+0.973,
2001/08/12,06:30:05,VB,,+12.009
2001/08/12,06:33:03,HG,+0.973,
2001/08/12,07:30:05,VB,,+12.009
2001/08/12,07:33:03,HG,+0.973,
2001/08/12,08:30:05,VB,,+12.009
2001/08/12,08:33:03,HG,+0.973,
2001/08/12,09:30:05,VB,,+12.009
2001/08/12,09:33:03,HG,+0.973,

User specified that the ',' character be used as the column delimiter.

Two ',' characters precede the data for parameter 'VB' because it is allocated to *Sensor Slot* #1 (slot# + 1). Refer to example in section 5.3 Main Menu: SENSOR LOG TABLE.

A single ',' character precedes the data for parameter 'HG' because it is allocated to *Sensor Slot* #0 (slot# + 1).

7.1. SHORT-FORM MENU

The PDAS logger provides special characteristics when the *ENTRY* password (see section 4.1) is set to a ' ' (spacebar). These characteristics are as follows:

- The *ENTRY* password protection is disabled.
- A SHORT-FORM MENU is displayed prior to entering the Main Menu. This SHORT-FORM MENU is as follows:

AMASS Data Technologies Inc. PDAS/MDM E050
Firmware(c)William P.Thomas 1996-99/2000-01

LS - Log Status
LD +yyyy/mm/dd - Retrieve from Date
LR +xxxxx - Retrieve xxx log records
VD - View Data
M - Main Menu

The selections 'LS', 'LR' and 'LD' are described in the previous section (7). *View Data* allows the user to view ALL sensors at once and their corresponding real-time data. The real-time data is updated once a second. Unlike the View Data facility obtained from the Main Menu, typing "VD" allows the user to view, at once, all sensors that are configured in the *Sensor Log Table*. In addition, a header appears with the date and time updated once a second.

DATE: 2002/02/10
TIME: 13:13:26

VB=+12.15
HG=+22.321

8. INSTALLATION

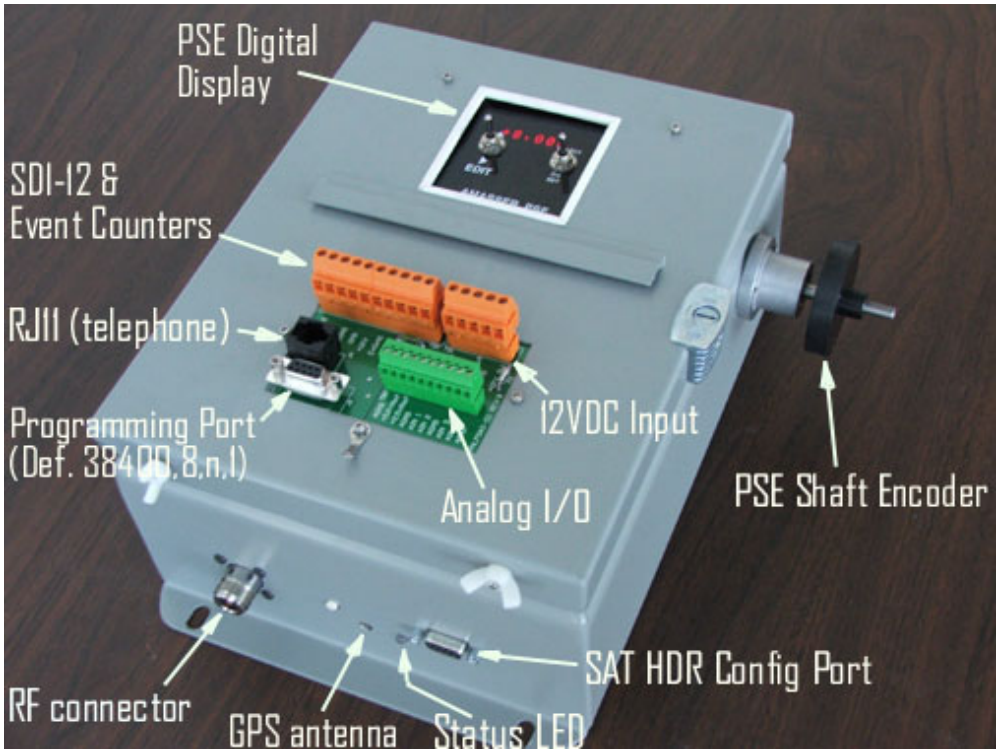


Figure 5. PDAS-III with /PSE/D and /HDR options.

8.1. Mechanical

The AMASSER PDAS loggers may be attached to a flat surface using screws with flat washers, or ¼" bolts through the holes located in the mounting brackets.

8.1.1. Shaft Encoder Setup

Models that feature the built-in shaft encoder ("PSE" and "PSE/D" options only) may be used to measure water level. For this purpose the unit may be attached to a horizontal or vertical surface in a gauge house with the shaft extending horizontally over the stilling well. Pulleys supplied by AMASS Data are secured to the Delrin hub using three 6-32 Stainless Steel screws. The threaded shaft also accepts standard L&S or F&P clamping assemblies. With suitable mechanical coupling, even linear positions may also be measured. For more information on the physical characteristics of the PDAS product line refer to *Specifications.*

The sensor may be installed in any orientation that a particular application may require. Weights or other mechanical loads at right angles to the shaft center-line should not exceed 10 lb (4.5 kg). Larger loads will distort the bearings, increase the starting torque, and decrease the bearing life.

8.2. Electrical

The PDAS-III must be connected to a +12V power supply. This connection is as per section 8.3. PDAS products are internally protected against transient voltages and lightning surges on the signal input lines. However,

IT IS ESSENTIAL TO PROVIDE PRIMARY EXTERNAL LIGHTNING PROTECTION.

All connections are done externally by means of detachable terminal strips. An externally-mounted RJ11 connector is provided for modem-equipped models (option "/MDM" and "/MDM/V"). The NEMA environmental enclosure need not be opened except for servicing.

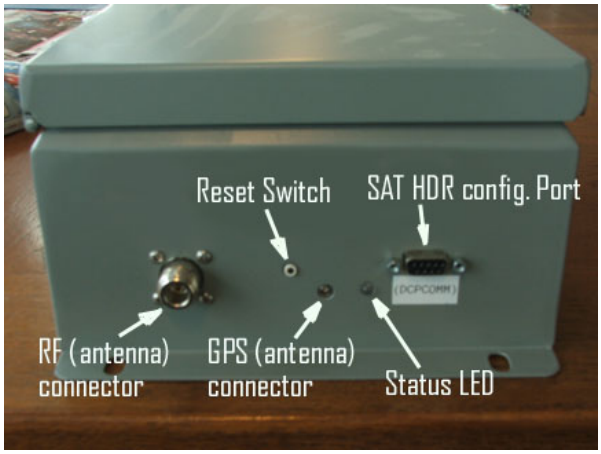


Figure 6. GOES related connections for the PDAS-III.

8.2.1. \PSE Models

The built-in shaft encoder that is included with /PSE models features a 9V battery. This battery provides a power backup of the PSE shaft encoder in the event of an interruption in the main power supply. WHEN INSTALLED, the 9V battery-backup provides absolute tracking of the shaft, even with intermittent power. The battery provides backup for a total of approximately 7 days.

NOTE: The 9V battery on /PSE models is for backup of the shaft encoder sensor, NOT THE DATA LOGGER

FOR REV H SYSTEMS (refer to the Serial Number), THE 9V BACKUP IS PROVIDED WHEN THE BATTERY IS INSTALLED AND MAKING CONTACT IN THE HOLDER. There is no jumper to install as with previous models. Note that the battery must be installed AT THE TIME OF INSTALLATION when the main power source is connected to the system, otherwise the PSE board will be drawing current from it and drain it within 7 days.

8.2.2. /HDR Models

Models with GOES telemetry are equipped with a Seimac SAT HDR High Data Rate transmitter. The SAT HDR is internally connected to the PDAS-III for communications and power. All connections to the SAT HDR (and PDAS-III) that are to be made by the user are done externally. There is no need to open the enclosure (except to install the 9V battery in models with the "PSE" option). In fact, it is advisable to not open the enclosure in the field, especially in high-humidity environmental conditions.

The connections to be made to the SAT HDR are shown in Figure 6. They consist of a GPS antenna connected to the female MCX connector as well as a YAGI antenna connected to the RF connector. The requirements of the antennas is described in the manual for the SAT HDR which is included with the logger. Note the "SAT HDR Config Port" which is used for configuring the SAT HDR via direct connect with a computer and the DCPCOMM software package that is also included with the logger. Visit http://www.seimac.com for more details.

The Operating System of the SAT HDR is upgradable via the Auxiliary port with DCPCOMM. The Auxiliary port is only accessible from within the PDAS-III enclosure. It is not reccommended to perform this procedure in the field.

Upon power-up the SAT HDR performs an internal initialization and self diagnostic which requires about one minute. This period will be indicated by the status LED on the SAT HDR as described below. The PDAS-III will not be able to communicate with the SAT HDR during this time.

The function of the status LED is described in the following paragraph taken from the *SAT HDR Programmer's Guide*.

"SAT HDR GOES Status LED"

The status LED on the SAT HDR GOES serves many functions. On power up, it will cycle through red, green and yellow while performing internal diagnostics. In the event that the failsafe is tripped, it will flash red. In the event that other faults are detected, it will flash yellow. While online, the LED will be solid green while the GPS subsystem is acquiring a fix, solid red while transmitting or it will be off while in a low power state. It is possible to determine the state of the SAT HDR GOES at any time by briefly depressing the switch beside the LED. It will flash for 10 seconds as red (failsafe tripped), yellow (hardware, power supply fault or a missed GPS fix), or green (OK). During the first fix the LED will flash yellow if the switch is pressed. If the LED remains solid yellow for ten seconds the SAT HDR GOES transmitter is offline. Depressing the switch for more than 4 seconds will reset the failsafe state and force the SAT HDR GOES into reset for 60 seconds. During this 60 seconds the internal software of the unit may be updated through DCPCOMM."

IT IS IMPERATIVE THAT THE GOES TRANSMITTER OPERATE IN AN AIRTIGHT ENVIRONMENT WITH LOW HUMIDITY. Ensure that the strain-relief is tightened securely onto the GOES antenna cable. It is desirable to have a bag of dessicant in the enclosure to reduce humidity.

8.2.3. /PMDM Models

Loggers with "/PMDM" in the product name are equipped with a built-in modem. Power is provided internally to the modem via a cable inter-connecting the modem to the logger. The only external cable connection to the modem is a telephone line that must be plugged into the RJ11 (see next section). Note that the modem baud rate defaults to 1200 unless otherwise notified.

NOTE: DO NOT DISCONNECT/RECONNECT THE INTERNAL MODEM-LOGGER INTERFACE CABLE WHILE THE PRIMARY POWER IS APPLIED. If a reset of the modem must be made, reset the power to the whole system.

8.2.4. /HDR/MDM models

Loggers with "/HDR/MDM" in the product name are equipped with both a modem and a GOES transmitter. These systems are configured to provide GOES transmissions just as any other PDAS-III/HDR, but also allow the station to be accessed via modem. Both sections 8.2.2 and 8.2.3 above are applicable.

8.3. Connectors, Cables & Terminal Strips

- 9-pin DB9S comm connector for serial RS-232 communications to your computer (see Figure 7 below). A *Programming Cable* is supplied with your PDAS for direct communications to your computer (38400 baud, 8 data bits, 1 stop bit, no parity as per section 4.1).

- Various detachable screw-terminal modules (Figure 7) that is secured to the cover of the logger enclosure. These terminals are for the SDI-12 data, +12V input and ground, switched +12V output, all analog inputs and outputs. Sockets allow for easy replacement/installation of fuses.

- RJ11 for connection to your telephone line. Only models with "/MDM" in the product name are equipped with built-in modems.

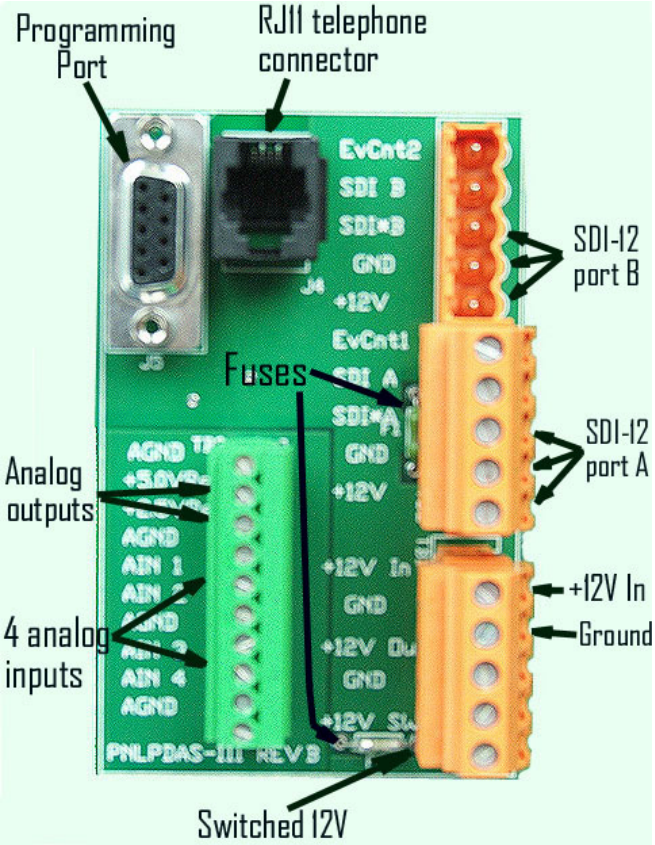


Figure 7. Detachable terminal strip mounted to all PDAS-III (rev H) loggers.

ANALOG OUTPUTS. Voltage references (+5VDC, +2.5VDC).

4 ANALOG INPUTS: channels #1, #2, #3 and #4. These may be used as single-ended inputs or as two differential pairs: #1-#2 and #3-#4.

SWITCHED +12VDC OUTPUT.

+12V IN & GROUND: These are the battery/power source connections.

SDI-12 ports A & B: Each of these ports consists of a data line, 12V and ground.

RJ11 TELEPHONE CONNECTOR. Only applicable to models that have a built-in modem, i.e. option "/MDM" or "/MDM/V". Note that the connector appears on all models.

PROGRAMMING PORT. Serial port for connection to a computer for set-up of the logger and direct retrieval of data. The default settings for this port are 38400 baud, 8 data bits, 1 stop bit, no parity.

FUSES. These should be 2A. These are replaceable.

8.4. Jumper Configuration

8.4.1. …of SDI-12 Channels

Refer to App. F for locating the various jumper blocks.

The PDAS loggers include two SDI-12 channels. These channels are configured for standard SDI-12 sensors by default. However, they may also be setup for use with SDI-12/RS485 sensors. This configuration is accomplished via the proper jumper selection.

CHANNEL A:
Locate JB5 and JB13. Note that 'JB5' is duplicated on these boards. Locate the 'JB5' with three pins as shown below:

… for standard SDI-12:
Set JB5 to 'HC' and install JB13.

… for SDI-12/RS485:
Set JB5 to '485' and remove the jumper in JB13.

CHANNEL B:
Locate JB6 and JB14. Note that 'JB6' is duplicated on these boards. Locate the 'JB6' with three pins as shown below:

… for standard SDI-12:
Set JB6 to 'HC' and install JB14.

… for SDI-12/RS485:
Set JB6 to '485' and remove the jumper in JB14.

8.4.2. /MDM: First-Time-Initialization

Models with '/MDM' in the product name are equipped with a built-in PMDM environmental modem. First-time initialization of the PMDM may be required in the following circumstances:

- Following the installation of a new processor in the PMDM modem with updated firmware.
- To re-establish communications between the PMDM and the PDAS logger. (SEE section 5.6.1)

The location of the First-Time-Initialize is as follows:

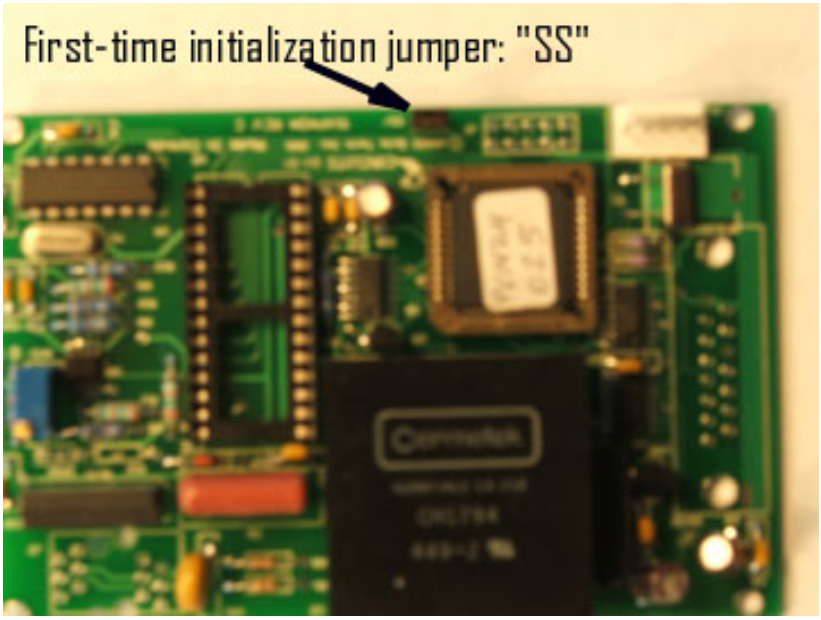


Figure 8. Location of first-time-initialization jumper on the PMDM modem.

NOTE: DO NOT DISCONNECT/RECONNECT THE INTERNAL MODEM/LOGGER INTERFACE CABLE WHILE THE PRIMARY POWER IS APPLIED. If a reset of the modem must be made, reset the power to the whole system.

TO PERFORM A FIRST-TIME-INITIALIZATION:

1. Install the first-time-initialize jumper as shown in Figure 8.
2. Power-up the system. Wait at least 10 seconds for the initialization cycle to complete.
3. Remove the jumper.
4. Disconnect the power.
5. Reconnect the power to the system. The First-Time-Initialize is complete.

ENSURE THAT THE FIRST-TIME-INITIALIZE JUMPER IS REMOVED DURING NORMAL OPERATION; OTHERWISE THE PMDM WILL REVERT TO 1200 BAUD EVERY TIME THE POWER TO IT IS CYCLED.

9. MAINTENANCE

Maintenance of any PDAS logger is very minimal. The only components that eventually require replacement are batteries.

All units include a Lithium battery which is used to run the clock and back-up the RAM space which stores the date, time, unit identification number, GOES configuration and sensor set-up. NEVER REMOVE THE LITHIUM BATTERY UNLESS IT NEEDS TO BE REPLACED. Check the battery voltage with it in its holder.

NEVER REMOVE THE LITHIUM BATTERY UNLESS IT IS BEING REPLACED.

Doing so will erase the NVRAM and all calibration tables for the AIS (Analog Input Subsytem).

The Lithium battery should be replaced when its voltage drops below 2.25V. The voltage of the Lithium battery can of course be monitored by the on-board AIS by selecting **RTC Lithium V** from the internal sensor list as shown in section 5.3.2 INTERNAL (ANALOG) SENSORS. However, monitoring the voltage of the Lithium battery does reduce its life expectancy down to approximately 5 years. Alternatively, the user can read the voltage of the Lithium battery at will by issuing the following *Direct Communication Command:* **MA6** (see section A/D MEASUREMENT COMMAND: on page 7-2). The normal life expectancy of the Lithium battery is about 10 years.

To replace the Lithium battery:

1. Disconnect power.
2. Open the logger enclosure to gain access to the printed circuit board.
3. Locate the Lithium battery (see *Appendix D)* and replace.
4. The NVRAM, that is the program(s), is now erased. Fortunately, the BOOT LOADER, which allows the user to upload new programs, is stored in non-volatile memory in the AT89S8252. Start-up the logger and load a new program using the BOOT LOADER (See 4.2). Once the program is loaded select "First-Time Initialize" from the BOOT LOADER menu. This is to ensure that the unit is properly initialized.
5. Ensure that the logger is properly initialized and functional by communicating via your terminal which is connected to the programming port (38400 baud, 8 data bits, 1 stop bit, no parity but with hardware flow control).
6. Set the date and time.
7. Reassemble the logger enclosure.

The 9 volt battery that is included with option "/PSE" (built-in shaft encoder) serves to ensure continuous power to the shaft encoder which enables absolute tracking in the event of power interruptions. Unlike the Lithium battery, the 9 V unit does NOT draw current continuously but rather, only when the primary power source has been interrupted. Therefore, its life expectancy is entirely dependent on its use. Replace when the voltage drops below 7 V.

A NOTE REGARDING RETURNS: AMASS Data will gladly answer any question with regards to the operation of its products. If you believe a product is defective fill-in the Return Authorization Form on-line at http://www.amassdata.com. Our technical personnel will then contact you to either troubleshoot the equipment or advise you to send it to the factory. Equipment returned to the factory will only be processed if a completed RMA form is included with the shipment.

10. SPECIFICATIONS

Processor - Atmel 89S8252 @ 11.0592 MHz.
Internal RAM - 256 bytes RAM

External Memory

site 1 - Data space: 4 slots of 32 kbytes SRAM (Li bat backup)
site 2 - Code space: 2 slots of 64 kbytes SRAM (Li bat backup)
sites 3&4 - 1 Mbyte non-volatile flash (32768 records)

Connectors

- 9 pin DB9S comm connector (RS-232)
- det. Terminal module for SDI-12, +12VDC input, analog inputs and outputs

AIS Input

Primary Voltage: (0 - 20V) ch#7
Lithium Battery Voltage (0-5V) ch#6
Internal Temperature (0 - 2.5V) ch#8

Ch#1 to #4 (external inputs):
User-configurable. Def: 0-5V

- 4 X (0-1V), #1, #2, #3, #4
- 4 X (0-2.5V), #1, #2, #3, #4
- 4 X (0-5V), #1, #2, #3, #4
- 4 X (+/-100mV), #1, #2, #3, #4

Analog Output

2.5V and 5V reference

GOES Support

The following are available (see price list):

- Support for Seimac SAT HDR
- Support for Microcom GTX-1.0

Environmental Characteristics

Operating : -40 to +55 C
Storage : -60 to +100C
Humidity : <= 100% non-condensing

Battery Backup

Standard CR2032 3VDC Lithium battery RAM backup (date, time, unit no., site description, sensor setup).

Event Counter Input

2 ports
Resolution - 16 bit

- 20 msec closure on port 1
- Frequency counter on port 2

Communications

- Direct to *Prog. Port* (DB9S): 38400 baud, 8 data bits, 1 stop bit, no parity.
- Built-in modem (/PMDM option): max. 9600 baud, 8 data bits, 1 stop bit, no parity.
- Telecommunications via GOES transmitter. Outgoing messages only.

Power Consumption

< 7 mA w/o comm port connected
< 19 mA w/ comm port connected

Max. current < 100 mA with “PSE/D” display on

Real Time Clock

Motorola, adjusted to +/- 15ppm per year

Physical Characteristics

Basic Models in NEMA box:

Length – 254 mm. (10.0 in.)
Width - 200 mm. (8.0 in.)
Depth – 125 mm. (5.0 in)
Weight - 4 Kg (10 lb.)
Mounting – flange with 8mm holes

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702 Route 105 Chelsea QC J9B 1L2
TEL: 819 8270077 FAX 819 827-4305
Email: sales@amassdata.com Web page at http://www.amassdata.com

APPENDIX A: SDI-12 COMMUNICATIONS ERROR MESSAGES

While communicating with SDI-12 sensors, the PDAS may generate any one of the following error messages as a result of the tight timing constraints of the SDI-12 protocol. Note that the PDAS is multi-tasking and that the SDI-12 communications and data logging take precedence over RS232.

SDI-12 Communications Error Messages

ERROR NUMBER	MEANING
1	Timeout waiting for address of initial response
2	Timeout waiting for address following D0! Command
3	Character timeout – D0! Response string
4	Character timeout – Initial Response string
5	Waiting for Tx to finish

APPENDIX B: PSE Shaft Encoder Commands

Retrieve Data Commands

1. Get encoder value in scaled units
   - command: aM!, aM0!
   - response: a0001<cr><lf> data buf: <encoder value>
2. Start verification command
   - command: aV! or aV0!
   - response: a+<data buffer 1>+<data buffer 2>+<data buffer 3><cr><lf>
3. Get event counter value
   - command: aM3!
   - response: a0001<cr><lf> data buf: <event counts>
4. Get average, maximum and minimum encoder position
   - command: aM5!
   - response: attt1<cr><lf> data buf <average position>, ttt=(actual sampling period X # of samples) + 1 sec
5. Return data buffer
   - command: aD! or aD0! Response: a<data buffer><cr><lf>
6. Return identification string
   - command: aI! response: a<identificationstring><cr><lf>
7. Acknowledge active command
   - command: a! response: a<cr><lf>
8. Address query command
   - command: ?! Response: a<cr><lf>
9. Change SDI device (node) address
   - command: aA<new address>! Response: <new address><cr><lf>
10. Query Command
    - command: aQ0! or aQ1! or aQ2! or aQ3! etc… Response: a<information string><cr><lf>
11. Read Value of Set-up Parameter
    - command: aS0?!, aS1?!, aS6?! Response: a<data buffer><cr><lf>

Set Commands

1. Set encoder offset
   - command: aS0<offset>! Response: a<cr><lf>
2. Set encoder scale (units per revolution)
   - command: aS1<scale>! Response: a<cr><lf>
3. Set Scale of the Event Counter
   - command: aS3+<scale>! Response: a<cr><lf>
4. Set Mode of Event Counter
   - command: aS2+<mode>! See App. D for modes
   - Response: a<cr><lf>
5. Reset Event Counter
   - command: aS5! Response: a<cr><lf>
6. Set averaging parameters
   - command: aS6+<sampling period>+<number of samples>!
   - response: a<cr><lf>

APPENDIX C: PDAS Data formats

The PDAS supports three data formats in its log file: "Environment Canada Sequential", "Environment Canada Tabular (comma-delimited)" and our standard "Tabular" formats. The standard "Tabular" format is configurable in that its column delimiters are user-definable. **NOTE: only the ',' (comma) and <TAB> delimiters are recognized by the "AMASSER Grapher" graphing utility.**

The data format in use is user-selectable using **6 System Setup → 0 Log File Functions.** All subsequent data retrievals from the menu system will conform to the chosen format. Alternatively, the user can employ the LOG RETRIEVAL-BY-NUMBER COMMAND: (p.7-4) or the LOG RETRIEVAL-BY-DATE COMMAND: (p.7-5) to override the current settings and to download data based on the command message.

Examples of "Sequential" and standard "Tabular" are shown below. An example of "Environment Canada Tabular (comma-delimited)" is shown on pages 7-4 and 7-5.

ENVIRONMENT CANADA "SEQUENTIAL" FORMAT

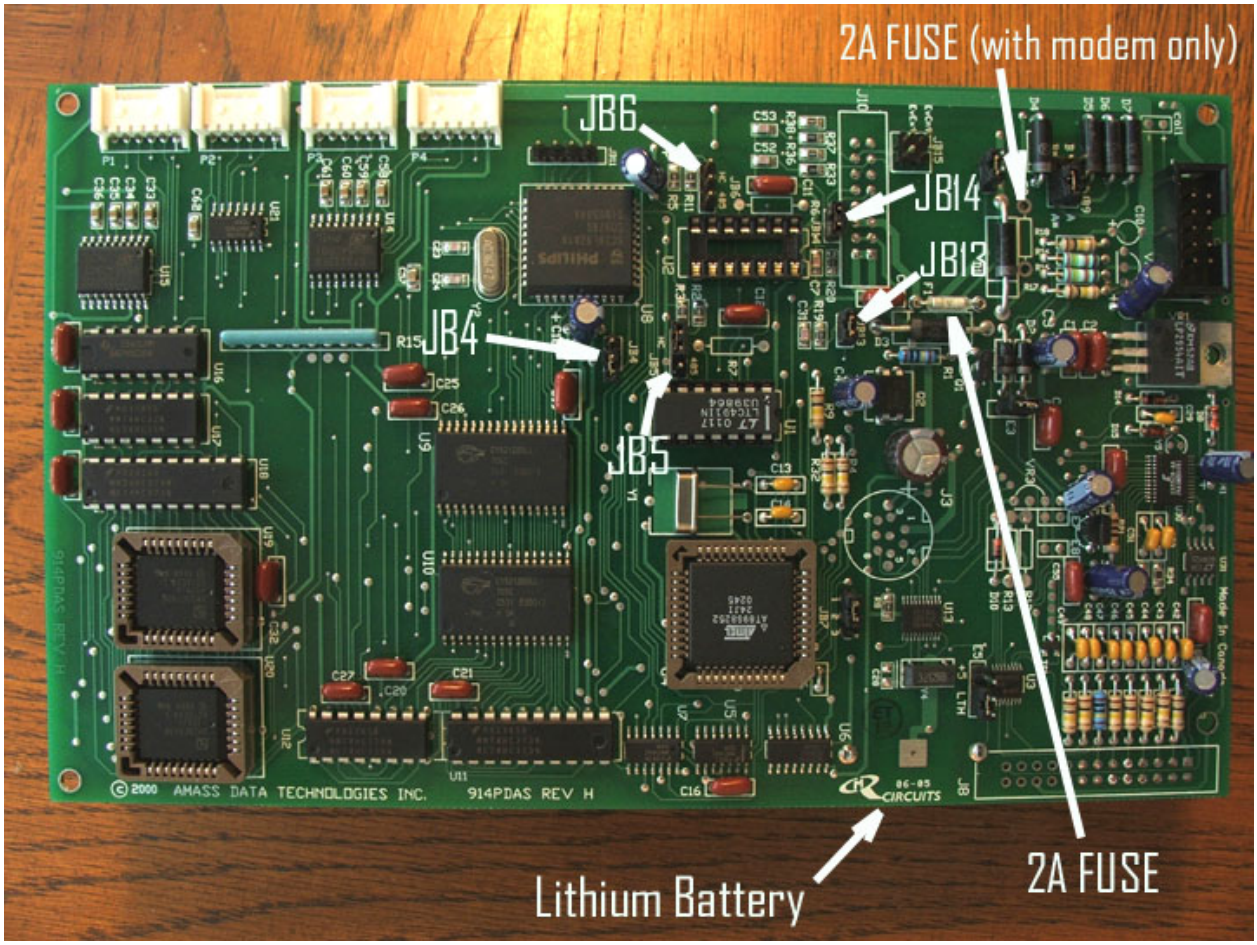
```
AMASS Data Technologies Inc.  PDAS/M XXX
Firmware (c)William P.Thomas 1996-97-98
DATE: 2001/08/10
TIME: 16:52:32
UNIT ID NO: T359478
SITE DESCRIPTION: BILL'S HOBBIT HOLE

 , 2001/08/11,
VB      ,  +12.012,00:30:00
HG      ,   +0.973,00:33:00
VB      ,  +12.010,01:30:00
HG      ,   +0.973,01:33:00
VB      ,  +12.010,02:30:00
HG      ,   +0.973,02:33:00
VB      ,  +12.009,03:30:00
HG      ,   +0.973,03:33:00
VB      ,  +12.009,04:30:00
HG      ,   +0.973,04:33:00
VB      ,  +12.009,05:30:00
HG      ,   +0.973,05:33:00
VB      ,  +12.009,06:30:00
HG      ,   +0.973,06:33:00
VB      ,  +12.009,07:30:00
HG      ,   +0.973,07:33:00
VB      ,  +12.009,08:30:00
HG      ,   +0.973,08:33:00
VB      ,  +12.009,09:30:00
HG      ,   +0.973,09:33:00
```

STANDARD TABULAR FORMAT (USING <TAB> COLUMN DELIMITER)

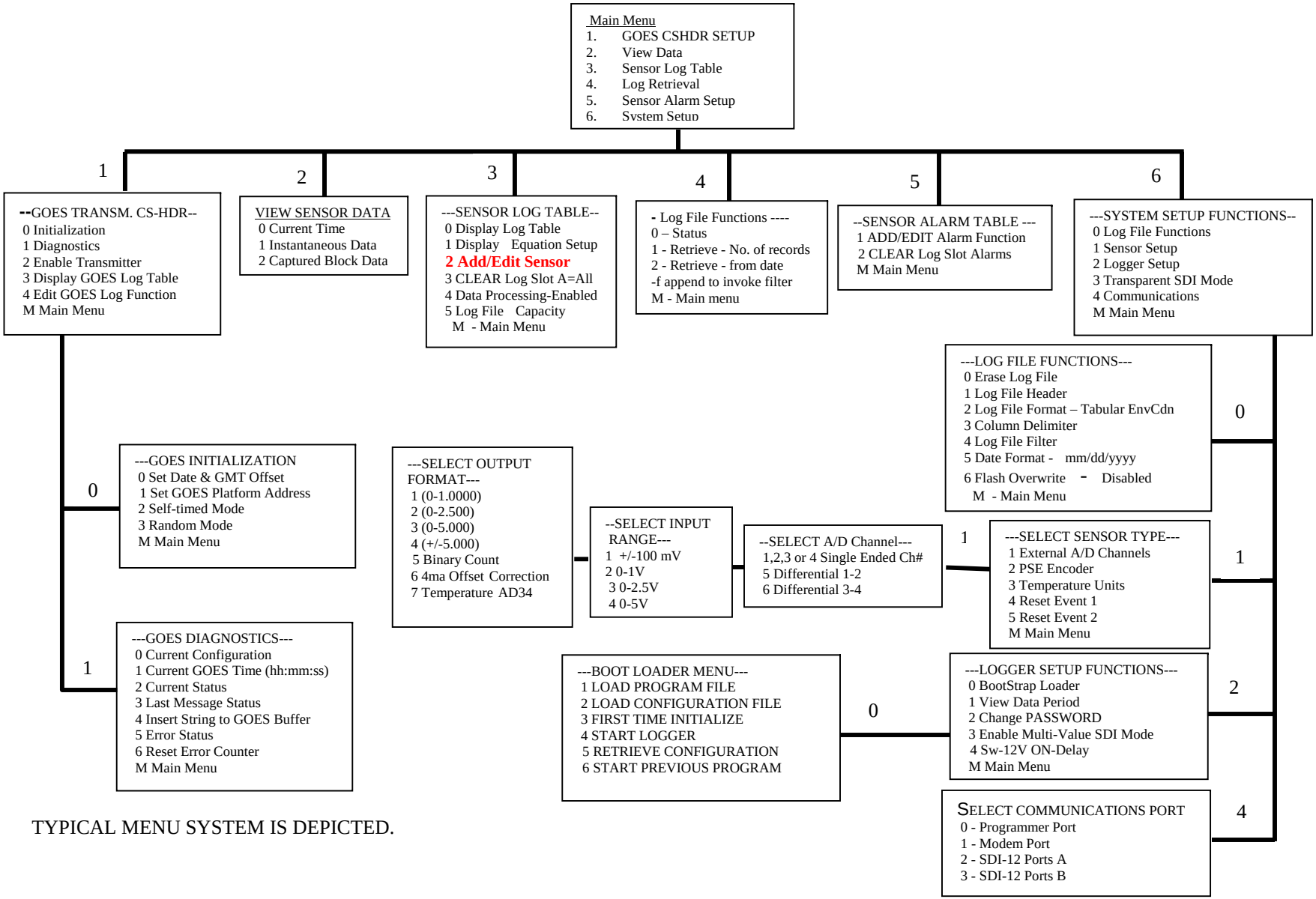
AMASS Data Technologies Inc. PDAS/M XXX
Firmware (c)William P.Thomas 1996,97,98,99,2000,2001
DATE: 1998/12/16
TIME: 10:25:36
UNIT ID NO: 01
SITE DESCRIPTION: Utopia

DATE	TIME	LABEL	HG	VB
1998/12/16	00:30:00	VB		+12.012
1998/12/16	00:33:00	HG	+0.973	
1998/12/16	01:30:00	VB		+12.010
1998/12/16	01:33:00	HG	+0.973	
1998/12/16	02:30:00	VB		+12.010
1998/12/16	02:33:00	HG	+0.973	
1998/12/16	03:30:00	VB		+12.009
1998/12/16	03:33:00	HG	+0.973	
1998/12/16	04:30:00	VB		+12.009
1998/12/16	04:33:00	HG	+0.973	
1998/12/16	05:30:00	VB		+12.009
1998/12/16	05:33:00	HG	+0.973	
1998/12/16	06:30:00	VB		+12.009
1998/12/16	06:33:00	HG	+0.973	
1998/12/16	07:30:00	VB		+12.009
1998/12/16	07:33:00	HG	+0.973	
1998/12/16	08:30:00	VB		+12.009
1998/12/16	08:33:00	HG	+0.973	
1998/12/16	09:30:00	VB		+12.009
1998/12/16	09:33:00	HG	+0.973	

APPENDIX D: PDAS-III CIRCUIT BOARD



APPENDIX E: Menu Map



TYPICAL MENU SYSTEM IS DEPICTED.

APPENDIX F:SAT HDR Error Codes

Communication Fault Codes

When a communication error is detected the SAT HDR GOES will post error codes, as listed below, to an error register which can be accessed using **Diagnostics → Error Status**. Each error register entry will consist of two bytes, the command that caused the error and the error code. In the case of a timeout error, the command byte will always be 0. The maximum amount of time that the SAT HDR GOES will wait for a command is programmable through DCPCOMM. The error register will contain 4 most recent entries.

CODE	DESCRIPTION
0x00	No error
0x01	Illegal Command
0x02	Command rejected
0x03	Illegal checksum (or too much data)
0x04	Timeout (or too little data)
0x05	Illegal parameter
0x06	Transmit buffer overflow

Internal Fault Codes

In addition to communication errors the SAT HDR GOES will post internal faults to the error register. The two-byte posting format will be followed with the command byte set to 0x1f. The internal fault codes are listed in the following table.

CODE	DESCRIPTION
0x10	Hardware Fault
0x11	GPS fix fault
0x12	Power Supply fault
0x13	Software fault
0x14	Failsafe fault
0x15	GPS Time Synchronization fault
0x16	SWR (RF load) fault

SAT HDR GOES Status LED

The status LED on the SAT HDR GOES serves many functions. On power up, it will cycle through red, green and yellow while performing internal diagnostics. In the event that the failsafe is tripped, it will flash red. In the event that other faults are detected, it will flash yellow. While online, the LED will be solid green while the GPS subsystem is acquiring a fix, solid red while transmitting or it will be off while in a low power state. It is possible to determine the state of the SAT HDR GOES at any time by briefly depressing the switch beside the LED. It will flash for 10 seconds as red (failsafe tripped), yellow (hardware, power supply fault or a missed GPS fix), or green (OK). During the first fix the LED will flash yellow if the switch is pressed. If the LED remains solid yellow for ten seconds the SAT HDR GOES transmitter is offline. Depressing the switch for more than 4 seconds will reset the failsafe state and force the SAT HDR GOES into reset for 60 seconds.

SAT HDR Software Updates

New software releases of the SAT HDR are managed by Seimac Ltd. Please refer to the Seimac website for updates and instructions using DCPCOMM: http://www.campbellsci.ca

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